



Universiteit Leiden

Appendices to the Course and Examination Regulations Master's Programmes Faculty of Science

valid from September 01, 2014

Appendix 1: Master degree programmes

MSc Mathematics.....	2
MSc Computer Science.....	5
MSc ICT in Business	8
MSc Media Technology	11
MSc Astronomy	13
MSc Physics	19
MSc Chemistry.....	28
MSc Bio-Pharmaceutical Sciences	32
MSc Biology.....	40
MSc Life Science and Technology (LS&T)	51
Specialisation Science-Based Business	54
Specialisation Science Communication & Society	58
Specialisation Education.....	62

Appendix 2

E-prospectus..... www.studiegids.leidenuniv.nl

MSc Mathematics

CROHO-number 66980

Leiden University offers six specialisations of an MSc programme in mathematics. Three of these correspond to research specialisations in the Leiden Mathematical Institute. The remaining three are the mathematics specialisation of the research MSc with Science-Based Business (SBB), Science Communication & Society (SCS) and Education (EDU) specialisations, which are described separately in this Appendix.

The duration of each programme is two years (120 EC). Students who complete the programme receive the degree Master of Science in Mathematics, with specification of the specialisation, if applicable. Details are provided below. All specialisations have the same Director, the same Board of Examiners, and the same Department Teaching Committee. A Board of Admissions will advise on admissions.

Candidates with a BSc degree or equivalent can apply for admission. The admission guidelines are given below for each specialisation. Individual combinations of the research programmes, with research projects from different groups, are possible in principle, depending on the decision by the Board of Examiners. The admission process may include an interview with the Board of Admissions. Foreign applicants must provide proof of proficiency in English (IELTS level ≥ 6.0). Admission is possible throughout the year, but we advise foreign students to start in September or February.

The goal of each programme is to train the student as an independent researcher, and to develop the necessary skills and proficiency to advance his/her career.

Specialisation

Algebra, Geometry and Number theory

Description

The MSc programme Algebra, Geometry and Number theory leads students to a high level of knowledge in this area. It consists of advanced courses from the field and a final research project including a master thesis and an oral presentation of it. Students with this MSc in Mathematics are admissible to a PhD programme. The programme is suited as preparation for an academic career, in particular via a subsequent PhD study, but also for a career as mathematical researcher outside the universities.

Qualifications for admission

Students from any university in The Netherlands with a BSc degree in Mathematics or with a BSc major in Mathematics will be admitted to the programme.

For all other (international) candidates, the Board of Admissions will judge the equivalence to these BSc degrees of their previous training. The choice in optional courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate.

Programme

For each student a programme will be tailored individually. It consists of a choice of advanced courses (at least 60 EC; at least 30 EC of these must be obtained via courses of the Dutch Master Programme in Mathematics) from algebra, algebraic and analytic number theory, algebraic and differential geometry, topology, cryptology, combinatorics, a research project in mathematics (at least 40 EC, including 7 EC for the thesis and an oral presentation), and a free choice of courses from any field (maximum 20 EC); required is a total of at least 120 EC.

Specialisation

Applied Mathematics

Description

The MSc programme Applied Mathematics leads students to a high level of knowledge in this area. It consists of advanced courses from the field and a final research project including a master thesis and an oral presentation of it. Students with this MSc in Mathematics are admissible to a PhD programme. The programme is particularly suited as preparation for a career as mathematical researcher in industry, government and other institutions, but also for an academic career, in particular via a subsequent PhD-study.

Qualifications for admission

Students from any university in The Netherlands with a BSc degree in Mathematics or with a BSc major in Mathematics will be admitted to the programme.

For all other (international) candidates, the Board of Admissions will judge the equivalence to these BSc degrees of their previous training. The choice in optional courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate.

Programme

For each student a programme will be tailored individually. It consists of a choice of advanced courses (at least 60 EC; at least 30 EC of these must be obtained via courses of the Dutch Master Programme in Mathematics) on differential equations, dynamical systems, analysis of industrial problems, measure- and integration theory, probability theory, statistics, functional analysis, numerical analysis, operations research, a research project in mathematics (at least 40 EC, including 7 EC for the thesis and an oral presentation), and a free choice of courses from any field (maximum 20 EC); required is a total of at least 120 EC.

Specialisation

Statistical Science for the Life and Behavioural Sciences

Description

The MSc programme Statistical Science provides students with a thorough introduction to the general philosophy and methodology of statistical modelling and data analysis. Students gain knowledge of statistical methods and research designs as used in a broad range of empirical research, and practical skills such as statistical programming, statistical consultation, and written and oral presentation of research results.

Qualifications for admission

Students from any university in The Netherlands with a BSc degree in Mathematics or with a BSc major in Mathematics will be admitted to the programme without further requirements.

Students with a wide range of other bachelor degrees may also be eligible for admission. Their academic program must include at least one introductory course and one more advanced course in statistics or probability. The Board of Admissions will evaluate the candidate's preparation and motivation to succeed in the programme. To this end the student should submit a letter (1 page) stating his/her motivation for applying to the programme, a curriculum vitae, and a list detailing the courses and credits of his/her bachelor programme.

A proof of proficiency in English is required (IELTS level ≥ 6.0), except for native English speakers and students with a bachelor's degree from a university in the Netherlands.

Start of the Programme

The programme starts in September. In exceptional cases the Board of Admissions can decide to allow another starting date.

Programme

The nominal duration of the programme will be two years (120 ECTS). The study time may be substantially reduced for students with particular prior knowledge. The programme consists of courses and colloquia (84-90 EC), an internship (10 EC) and a Master Thesis (20-26 EC). The internship and Master Thesis may be combined (30-36 EC).

At least 108 EC should come from the official programme, leaving 12 EC free of choice.

Students should have at least 45 EC of the 60 compulsory courses to enrol for the 'Statistical Consultancy' course and internship. Students should have obtained at least 75 EC to start their thesis research.

Compulsory courses	EC	Level
Statistics, probability	9	400
Mathematics for statisticians	4	300
Statistical computation with R	3	400
Linear & generalized linear models and linear algebra	9	400
Introduction to the life and behavioural sciences	5	400
Multivariate and multidimensional data analysis	6	500
Bayesian statistics	6	500
Mixed and longitudinal modeling	6	500
Study design in the life and behavioural sciences	6	400
Statistical consulting	5	500
Advanced statistical computing	3	500
Internship	10	600
Thesis	20, 24 or 26	600
Electives	28, 24 or 22	≥ 500
Total	120	

Elective courses within the programme

Survival analysis	6	500
Statistical learning theory	4	500
Psychometrics and SEM	6	500
High-dimensional data analysis	6	500
Statistical genetics	6	500

MSc Computer Science

CROHO-number 60300

The Leiden Institute of Advanced Computer Science (LIACS) is the computer science institute of Leiden University. The LIACS curriculum includes four MSc specialisations in computer science. Two of these correspond to specialisations of LIACS, the remaining two are the computer science specialisation of the research MSc with Science-Based Business (SBB), and Science Communication & Society (SCS) specialisations which are described separately in this Appendix. In addition, LIACS offers two Master programmes in Media Technology and in ICT in Business, respectively.

The duration of each programme is two years (120 EC). Students who complete the programme receive the degree Master of Science in Computer Science, with description of the specialisation, if applicable. Details are provided below. All specialisations have the same Director, the same Board of Examiners, and the same Department Teaching Committee. A Board of Admissions will advise on admissions.

Candidates with a BSc degree in Computer Science or equivalent can apply for admission. The admission guidelines are given below for each specialisation. The admission process may include an interview with the Board of Admissions. Admission is possible throughout the year, but we advise foreign students to start in September or February. Foreign applicants must provide proof of proficiency in English (IELTS level ≥ 6.5 , TOEFL score of at least 570 on paper or 230 on computer or 88 iBT (TOEFL Internet)).

The goal of each programme is to train the student as an independent researcher, and to develop the necessary skills and proficiency to advance his/her career.

Specialisation

Smart Computing for Science and Society

This is the headline and vision of the master computer science at LIACS. The master program offers future-oriented topics in computer science, with a focus on both foundations and applications of these advanced algorithms and techniques (= Smart Computing). Collaborations with other disciplines (= for Science), with companies and with organisations (= for Society) are manifold, and students get a master degree with a strong emphasis on connecting research with applications.

Description

This MSc programme is intended to provide students with a thorough computer science background that will allow them to pursue careers in research or industrial environments. The strength of the programme is its individual approach: for each student an individually tailored programme can be designed. This programme consists of courses and seminars, a research project and a Master's thesis research project. The research clusters are Computer Systems, Imagery and Media, Algorithms, Foundations of Software Technology and Technology and Innovation Management. Students with an MSc in Computer Science are admissible to a PhD programme.

Qualification for admission

Students from any university in The Netherlands with a BSc degree in Computer Science or with a BSc major in Computer Science will be admitted to the programme.

For all other (international) candidates, the Board of Admissions will determine the equivalence of their previous training to these BSc degrees. The choice of the specialisation courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate.

Programme

The programme is 120 EC in extent, and consists of specialisation courses and seminars (first year; 60 EC in total), and two research projects in computer science (second year; 60 EC in total).

<i>Components</i>	Level	EC
Specialisation courses and seminars	500	60
Computer Science research project	600	18
Computer Science master's research project (incl. 7 EC for a thesis and an oral presentation)	600	42

Specialisation

Bioinformatics

Description

The main focus of the Bioinformatics specialisation is on *Data Analysis and Modeling*, which represents the unique expertise of the different research groups of Leiden University and the Delft University of Technology participating in this *research oriented* specialisation. This expertise is used to address issues like data capturing, data warehousing, data analysis and data mining that have become major challenges in the field of Bioinformatics due to the tremendous complexity and abundance of quantitative data in biology and medicine. On the other hand, bioinformatics heavily contributes to the identification of new fundamental computer science principles and the development of new informatics tools. Bioinformatics offers a unique new synthetic approach for formulating hypotheses and solving problems in (molecular-) biology versus the classical reductionistic approach.

Qualifications for admission

Students from any university in The Netherlands with a BSc degree in Computer Science or with a BSc major in Computer Science will be admitted to the programme.

For all other (national and international) candidates, the Board of Admissions will judge the equivalence of their previous training to these BSc degrees.

Programme

The programme is 120 EC in extent. The programme is outlined below.

<i>Core Programme</i>	Level	EC
Pattern Recognition	500	6
Databases and Data mining	500	6
Functional Genomics and Systems Biology	500	6
Computational Molecular Biology	500	6

Methodology

Methodology of Science and Engineering 500 4

Every student of the Bioinformatics specialisation has to complete the core programme and the course Methodology of Science and Engineering.

Specialisation Courses 500 20

A choice can be made out of different specialisation courses. The specialisation courses have level 500, and range from 3 - 6 EC. The total of 20 EC is indicative and depends on the extent of the student's support programme and research assignment. The selection of the specialisation courses takes place in coordination with the Bioinformatics specialisation study adviser.

Support Programme 500 12

For each student a support programme will be defined by the Bioinformatics specialisation study adviser. The support programme consists of tutors or courses in Life Science, Computer Science, Mathematics, or of optional courses for deficiency programmes. The support programme will consist of a maximum of 12 EC.

Research assignment 600 15

Master's research project (incl. thesis and oral presentation) 600 45

MSc ICT in Business

CROHO-number 60205

The Leiden Institute of Advanced Computer Science (LIACS) is the computer science institute of Leiden University. LIACS offers a research master on the management and application of ICT in a business context.

The duration of the programme, which is taught entirely in English, is two years (120 EC). The programme starts in September and in February. Students who complete the programme receive the degree Master of Science in ICT in Business.

Description

Rapid changes in information and communication technology (ICT) and its applications over the last years have caused major changes for organisations, industries, and individuals. The internet, information systems, and communication technology in general, have radically impacted our professional and personal lives. They challenged our thinking on physical, geographical and industry boundaries, on distance, speed and communication. The MSc ICT in Business programme aims at providing a deeper understanding of the issues, challenges and opportunities in this area, with a specific focus on the management and alignment of ICT in a business and socio-technical context. The programme builds on a foundation of Computer Science that students bring from their bachelor's education.

Qualifications for admission

To enter the MSc programme in ICT in Business, a bachelor's degree in Computer Science or a closely related subject is required. Each application is considered individually. The Board of Admissions assesses whether the candidate's academic background and work experience can be considered to be equivalent to a bachelor's degree in Computer Science. The admission process may include an interview with the Board of Admissions.

Foreign applicants must provide proof of proficiency in English (IELTS \geq 6.5). Students who have a BSc in Computer Science from Leiden University are directly admissible.

Programme

The master ICT in Business consists of 15 months of course-work, and a 34 EC thesis project, often based on an in-company project. The courses cover business foundations, ICT & Business topics, research methods and electives. The electives allow students to individualise their programme and accommodate special interests. In addition there are possibilities to customise the programme through international exchange programmes. Courses are typically offered in a combination of lectures, case studies, projects, company visits, and student presentations. Many activities are based on team work, whereas research colloquia strengthen the individual's research competence.

Curriculum outline ICT in Business

The curriculum depends on the student's background. Students with a Leiden University bachelor in Computer Science, specialisation "Informatica en Economie" follow an alternative curriculum (see below). All the other students follow the main curriculum.

The main curriculum consists of the following components:

Components

	Level	EC
Global Business game	400	1
Marketing & Corporate Communications	500	3 *
System's Development and Project Management	500	6
Strategy: Process, Content, Context	500	6
ICT-enabled Process Innovation	500	3
Behavioural and Analytical Decision Making	500	6
Software Engineering	500	3
Change Management	500	3
Accounting	500	3 *
Process Modelling	500	3 *
Research Methods	500	6
Finance	500	3 *
Leading and Managing People	500	5
Managing the Digital Business	500	3
ICT Architectures	500	6
Business Intelligence	400	3 *
Managing Innovation	500	3
Research Colloquia	500	4
Capstone Cases	500	3
Electives	500	9 *
Thesis Research Project	600	38
		120

The alternative curriculum consists of 24 EC of electives, in total replacing the courses marked with an *.

The electives need approval by the Board of Examiners *before* the courses can be taken. Without this preliminary approval we cannot guarantee these electives to be part of the curriculum.

Programme for candidates with working experience

A special programme is offered to professionals with at least three years of working experience. These professionals should have a BSc degree in Computer Science or equivalent to be able to participate in the following programme.

Components

	Level	EC
ICT Architectures	500	6
Strategy: Process, Content, Context	500	6
Behavioural Decision Making, Managing People & Organising	500	9
Finance and Accounting	500	6
Methodology and Research Approach	500	6
Specialisation courses	500	30
Research Participation & Scientific Reporting	500	19
MSc Thesis Research Project	600	38
		120

The specialisation courses need approval by the Board of Examiners *before* the courses can be taken. Without this preliminary approval we cannot guarantee these courses to be part of the curriculum.

MSc Media Technology

CROHO-number 60206

The Media Technology MSc programme is a common initiative of the computer science institute (LIACS) within the Faculty of Science, and the Academy for Creative and Performing Arts. The duration of this programme is two years (120 EC). Students who complete the programme receive the degree Master of Science in Media Technology. Details are provided below.

Candidates with a BSc degree or equivalent can apply for admission. The admission process may include an interview with the Board of Admissions. Foreign applicants must provide proof of proficiency in English (IELTS level ≥ 6.5 or equivalent). The programme language is English.

Description

The Media Technology programme recognises creativity as an important factor in scientific innovation. It is a place where students, artists and researchers are allowed to formulate their own scientific questions and are encouraged to translate their personal inspirations and curiosities into manageable and compact research projects. To achieve this, the curriculum focuses on creative exploration and on the understanding of science and technology. Student projects most often involve creating actual products: software, hardware, something made from sticky tape perhaps. Because we are convinced that by doing / making / creating new insights into the underlying research question are encountered. The programme encourages its students to draw from the knowledge available throughout Leiden University and the ArtScience programme of the Royal Conservatoire and the Royal Academy of Arts in The Hague.

Qualifications for admission

Students holding a BSc degree in Computer Science from Leiden University or a BSc major in Computer Science from Leiden University will directly be admitted to the programme. For all other (possibly international) candidates, the Board of Admissions will judge the equivalence of their previous training to these BSc degrees. In principle, any prior field of study is applicable. Applicants are judged with observance of specific work- and training experience with regard to Media Technology.

Substitution for Compulsory Courses

Students can qualify for substitution of certain compulsory courses (see below) within their curriculum, when they can prove already having current knowledge of the topics dealt with. Substitution should be requested via the Executive Committee, and requires agreement by the lecturer of the course at hand. To receive agreement from the lecturer, the student must participate in the first lecture and present some form of proof that the knowledge was already obtained through other ways. The lecturer may decide to honour or turn down requests for substitution, based on the material provided by the student and the evaluation of such.

The student is not relieved from obtaining the required number of EC's through other ways. For every approved substitution, students must follow another (elective) course with the same number of credits or more. The contents of this replacement course must be a logical extension to the course for which substitution was granted, and must be of the same level.

Substitution is never granted for a compulsory course if the student in question has failed any exam or assignment for that same course. If substitution is granted, but the student decides to follow the course nonetheless, than the substitution is retracted (becomes non-valid) when he/she fails any graded part of the course in question.

Acceptance of Elective Courses

Elective courses can be done throughout Leiden University's various faculties, and from any accredited institute of higher education. For curricular acceptance of elective courses, prior permission must be obtained from the Media Technology Programme Board, which includes a member of the LIACS Board of Examiners. The decision to accept an elective course is based on course level, course load, course content and the student's statement of motivation.

Programme

The programme is 120 EC in extent.

Compulsory courses

	Level	EC
Visit to Ars Electronica Festival	400	1
Introduction to Programming	400	4
Human Computer Interaction	400	6
New Media & New Technologies	500	5
Creative Research	500	6
Cool Science	500	4
Perceptualisation	400	3
Sound, Space & Interaction	500	4
Web Technology	400	4
Research Seminar	500	5
Embodied Vision – Image & Vision	500	4
Hardware & Physical Computing	400	3
Meta Media	500	2
Language & Text	500	3
Essentials in Art & Music	500	2
Electives	500	14
Project	500	20
Graduation Project	600	30
		120

MSc Astronomy

CROHO-number 60200

The aim of the Leiden Observatory MSc programme Astronomy is to provide students with the proficiency and skills to pursue a successful career in science, or in society with a strong background in scientific thinking and understanding. The programme offers four specialisations, each comprising two years (120 EC).

The general “Research in Astronomy” specialisation focuses on major research themes including evolution of the universe, formation and evolution of galaxies, birth and death of stars, formation and occurrence of planets near other stars, astronomical instrumentation. Within the general “Research in Astronomy” specialisation, the student can choose from three streams, allowing either a broad research profile, or a profile that is more focused in a particular direction. The streams offered within the “Research in Astronomy” specialisation are:

1. “Research in Astronomy”: the most general option, allowing the broadest research profile;
2. “Cosmology”
3. “Astronomy and Instrumentation”.

In addition to “Research in Astronomy”, three other specialisations are offered, which combine the main elements of the research curriculum with topics in Science-Based Business (SBB), Science Communication & Society (SCS), and Education (EDU), and which are described separately in this Appendix.

Upon successful completion of the programme, students receive the degree Master of Science in Astronomy, with specification of the chosen specialisation.

All specialisations have the same Director, the same Board of Examiners, the same Department Teaching Committee, and the same Board of Admissions. In addition, the specialisations SBB, SCS, and EDU each have their own specialisation coordinator for the specialisation-specific part. Students with an MSc in any of these specialisations can also be admitted to a PhD programme in Astronomy.

Requirements for admission

Students with a BSc in Astronomy or the equivalent from Dutch universities participating in the NOVA research school are directly admitted to the programme.

For all other national and international candidates, the Board of Admissions will evaluate whether their degree is equivalent to a BSc in Astronomy. Students with Bachelor degrees in other sciences such as Mathematics, Physics, Chemistry, or Aerospace Engineering can also apply for enrolment. Candidates may be required to take introductory courses covering subjects in which they are deemed to be deficient. Additional admission guidelines are given below for each of the specialisations. The admission process may include an interview with the Board of Admissions. Admission is possible in September or February. Foreign applicants must provide proof of proficiency in English (IELTS \geq 6.5).

Selection of courses and Master Study Plan

For all specialisations, the selection of course work and research projects requires prior approval by the MSc Study Adviser. In individual cases a course from a different programme or field of study may be elected, but only after prior written approval by the Board of Examiners. Before starting such a course, the student should first discuss the

choice with the MSc Study Adviser, and only then contact the chairman of this board to obtain such approval. At the start of the Master's Programme, the student and the MSc Study Adviser together draw up a complete list of planned courses and projects (the Master Study Plan). Changes in the Master Study Plan in the course of the programme are possible, but always require prior approval by the Study Adviser.

Types of courses

A variety of courses is given each year. Specifics for all courses can be found in the E-prospectus and on the Astronomy Education website. Courses are given at different intervals: once per year (for courses that are compulsory in particular streams), once per 18 months, once per two years, or at irregular intervals. Sometimes courses are given only once. Students must therefore always consult the long-term teaching schedule (which is published on the Astronomy Education website and specifies the course schedule for the current and next year) when making their Master Study Plan. Courses are classified as follows:

Astronomy Core Courses (6 EC each): these are offered at regular intervals.

1. Origin and Evolution of the Universe;
2. Galaxies: structure, dynamics and evolution;
3. Stellar structure and evolution;
4. Interstellar medium.

General Astronomy Courses (6 EC each): these vary with time, and are offered at regular or sometimes irregular intervals. Examples include:

1. Large Scale Structure and Galaxy Formation;
2. Star and Planet Formation;
3. Computational Astrophysics;
4. The InterUniversity Courses (IAC), organized by the NOVA research school for astronomy.

Instrumentation-related Astronomy Courses (6 or 3 EC each): these vary with time, and are offered at regular or sometimes irregular intervals. Examples include:

1. Astronomical Telescopes and Instruments;
2. Detection of Light;
3. Radio Astronomy;
4. Astronomy from Space;
5. High Contrast Imaging;
6. Astronomical Systems Design;
7. Project Management in Science.

The course "Physics of Scientific Space Instruments" (offered by the Physics Department) is also in this category.

Specialist Astronomy Courses (3 EC each): these vary with time and are offered at irregular intervals; these courses provide in-depth introductions to specialised topics. Examples include:

1. Observational Cosmology;
2. Astrochemistry;
3. Databases and Data Mining in Astronomy;
4. High-energy Astrophysics;
5. Gravitational Lensing.

Non-Astronomy Courses; these must be selected from the courses offered by the Leiden MSc programmes in Physics, Mathematics, or Computer Science.

Astronomy Research Projects. Students in the specialisation “Research in Astronomy” carry out two astronomy research projects: the Minor (24 EC) and Major (36 EC) Research Project. Students in the SBB, SCS or EDU specialisations carry out only one research project: the Medium (30 EC) Research Project.

All research projects are carried out under supervision by a member of the scientific staff. The Major and Minor Research Projects must be of a different nature and be supervised by different persons. The Major Research Project can be started only after completion of the Minor Research Project. The maximum duration in calendar time of a Minor Research Project is eight (8) months, and that of a Major Research Project twelve (12) months. The Medium Research Project has a maximum duration in calendar time of ten (10) months.

The Medium and the Major Research Project are designated as the Master's Research Project; their total credit of 30 EC and 36 EC respectively include a 4 EC and 5 EC respectively Master's Thesis as well as a 1 EC public presentation (the Student Colloquium).

Specialisation Research in Astronomy

Description

This 2-year programme consists of advanced Astronomy courses, two research projects in Astronomy, and courses on science topics related to the field of Astronomy. It prepares the student for independent research in Astronomy.

Programme (120 EC)

The programme has the following structure:

<i>Year 1</i>	Level	EC
Minor Astronomy research project	500	24
Astronomy courses	400-500	24
Non-Astronomy courses	400-500	12
 <i>Year 2</i>		
Major (Master's) Astronomy research project	600	36
Astronomy courses	500	12
Non-Astronomy courses	400-500	12

The Astronomy curriculum must contain the following courses:

- *mandatory*: the Astronomy core course “Stellar Structure and Evolution” (6 EC);
- *a minimum of two* (2) other Astronomy core courses (12 EC);
- *one* (1) *or more* instrumentation-related Astronomy courses, accounting for at least 6 EC in total;
- *a choice of* Astronomy courses of any type (12 EC),
- *both* a Minor and a Major Research Project (60 EC).

One of the two courses “Science and the Public: contemporary and historical perspectives” and “Science Methodology” may also be chosen as a non-Astronomy course.

The programme may be adapted for Master's students who have not followed the Leiden Astronomy Bachelor programme. Upon recommendation by the MSc study adviser and written approval by the Board of Examiners, the Minor Research Project can be reduced to 15 EC with a simultaneous increase in the number of courses in Astronomy.

If compatible with the teaching schedule, the students will take these additional courses in their first semester. These additional courses can be selected from the normal courses in the Master's curriculum, and from the following courses in the Bachelor's curriculum:

- Astronomical Observing Techniques;
- Radiative Processes;
- Physics of Elementary Particles.

These students may also add Astronomy courses at the cost of the non-Astronomy courses, again after consultation with the MSc Study adviser and approval by the Board of Examiners.

“Stream” Astronomy and Instrumentation

Description

The stream “Astronomy and Instrumentation” within the specialisation “Research in Astronomy” offers the student the option to conduct a Research Master in Astronomy with a particular focus on advanced astronomical instrumentation, techniques, and instrument development.

Programme (120 EC)

The requirements for the two years are as follows:

	Level	EC
<i>Mandatory Courses:</i>		
Stellar Structure and Evolution	500	6
Astronomical Telescopes and Instruments	500	6
Detection of Light	500	3
<i>Choice of core/general/specialist Astronomy courses</i>	400-500	30
<i>Choice of instrumentation-related Astronomy courses</i>	400-500	15
Minor Research Project in General Astronomy	500	24
Major Research Project in Instrumental Astronomy (Master's Project)	600	36

The following remarks apply:

1. The specialist astronomy course “Databases and Data Mining in Astronomy” may be included as an instrumentation-related course in the above programme.
2. The courses Space Instrumentation (AE4880, 4EC) and/or Space Systems Engineering (AE4S12; 3EC), offered by the Department of Aerospace Technology of Delft Technical University may be included as instrumentation-related courses in the above programme.
3. Up to 12 EC of the core/general/specialist Astronomy courses may be replaced by non-astronomy courses, to be taken from the MSc programs in Mathematics, Physics, or Computer Science; among these 12 EC the student may also choose one of the two courses “Science and the Public: contemporary and historical perspectives” and “Science Methodology”.
4. The Major (Master’s) Research Project may involve designing, building or testing of an instrument or instrument system, or any combination of these activities. It may be carried out in any of the Leiden Astronomy or Delft Technical Physics labs, or at external organisations directly involved in astronomical instrumentation.

“Stream” Cosmology

Description

The stream “Cosmology” within the specialisation “Research in Astronomy” offers the student the possibility to conduct a Research Master in Astronomy with a particular focus on modern observational and theoretical cosmology. This stream is offered in collaboration with the Institute Lorentz for Theoretical Physics in the Department of Physics at Leiden University (LION). Fundamental elements are (physical and astrophysical) theory, data handling, and numerical simulation.

Qualifications for admission

In addition to the general admission requirements of the MSc programme in Astronomy, students should have successfully completed the BSc course “Physics of elementary particles”, or its equivalent, and should have in-depth knowledge of undergraduate courses with theoretical and mathematical emphasis, including quantum physics, electrodynamics, statistical physics, and complex analysis. The choice in elective courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate. The Board of Admissions will consider the contents of the candidate’s BSc curriculum when deciding on admission.

Programme (120 EC)

The requirements for the two years are as follows:

	Level	EC
<i>Mandatory Astronomy Courses:</i>		
Stellar Structure and Evolution	500	6
Origin and Evolution of the Universe	500	6
Large-scale Structure and Galaxy Formation	500	6
<i>Choice of:</i>		
Astronomy courses of any type	400-500	18
<i>Mandatory Physics Courses:</i>		
Particle Physics and Early Universe	500	6
Theory of General Relativity	400	6
<i>Choice of:</i>		
Related Physics courses	400-500	12
Minor Research Project in Cosmology	500	24
Major Research Project in Cosmology (Master's Project)	600	36

The Minor and Major Research Projects must be of a different nature and be supervised by different persons. The Major Research Project can be started only after completion of the Minor Research Project.

MSc Physics

CROHO-number 60202

Leiden University offers eight specialisations of an MSc programme in Physics. Five are research specialisations which are tied to research at the Leiden Institute of Physics (LION) or offered in conjunction with the department of Astronomy in Leiden or the department of Applied Physics at the Delft University of Technology. Three are combinations of the physics specialisation with Science-Based Business (SBB), with Science Communication & Society (SCS) and with Education (EDU). These double specialisations are described separately in this Appendix. The research specialisations are Biological and Soft Matter Physics, Quantum Matter and Optics, and Theoretical Physics; as well as Cosmology (in collaboration with the Department of Astronomy), and 'Casimir prePhD' (in the framework of the Casimir Research School, a joint undertaking between Leiden University and Delft University of Technology). The Casimir prePhD specialisation can be followed through selection only. Students admitted to the Physics Programme can apply after the first semester of their studies and are selected on the basis of their results.

The duration of each programme is two years (120 EC). Upon successful completion, students receive the degree Master of Science in Physics (with specification of the specialisation), which allows the pursuance of a PhD degree. Details are provided below. All specialisations have the same Director of Education, the same Board of Examiners, and the same Departmental Teaching Committee. A Board of Admissions advises on admissions to the Programme. Candidates with a BSc degree in physics or equivalent can apply for admission. The admission guidelines are given below for each specialisation. The admission process may include an interview with the Board of Admissions. Foreign applicants must provide proof of proficiency in English (IELTS level ≥ 6.5). Admission is possible throughout the year, but we strongly advise foreign students to start in September. For the Cosmology and 'Casimir pre-PhD' specialisations the start should be in September.

The goal of each programme is to train the student as an independent researcher, and to develop the necessary skills and proficiency to advance his/her career. In all specialisations therefore, it is possible for the optional part of the programme to choose courses offered by other universities or graduate schools. The programme should have sufficient level and cohesion, and the optional part in all cases requires prior approval of the Board of Examiners, to be obtained through the Study Adviser.

The research specialisations distinguish themselves by a setup and core of the curriculum which emphasizes the intended perspective and goal of that specialisation. In all cases, the programme consists of two components, a set of courses and one or more research projects. All specialisations offer research training which allows the pursuance of a PhD degree as a next step, although other career options remain fully open. The 'Casimir pre-PhD' specialisation puts emphasis on preparing for PhD research within the Casimir Research School, and requires a strong academic record for admission.

Specialisation

Research in Physics, theoretical

Description

The Research in Theoretical Physics specialisation prepares the student for scientific research towards the PhD in a broad range of topics, such as High Energy Physics and Particle Cosmology; Theoretical Physics of Life Processes; and Condensed Matter Theory. The master will also be well-equipped for industrial research or other problem-solving tasks that demand strong analytical and computational skills.

Qualifications for admission

Students from any university in the Netherlands with a BSc degree in Physics or Astronomy will be admitted to the MSc programme in Physics. For the Research in Theoretical Physics specialisation, in-depth knowledge is required of undergraduate courses with theoretical and mathematical emphasis: quantum physics, electrodynamics, statistical physics, and complex analysis.

For all other (international) candidates, the Board of Admissions will judge the equivalence of their previous training to these BSc degrees. The choice in elective courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate.

Programme

	Level	EC
Quantum Theory a + b ¹	400	9
Statistical Physics a + b ¹	400	9
Topics in Theoretical Physics ²	400	6
Courses from the Theoretical Physics courses on offer	400-600	12
Optional master courses from the MSc Physics programme ³	400-600	34
Academic and Professional Skills ⁴	400	2
Physics research project in Theoretical Physics	600	36
Master's thesis (8 EC) and oral presentation (4 EC)	600	12

Course List; Theoretical Physics

	Level	EC
Advanced Topics in Theoretical Physics I	600	6
Advanced Topics in Theoretical Physics II	600	6
Black Holes and Gravitational Waves	500	3
Complex Networks	400	6
Computational Physics	400	6
Effective Field Theory	500	3
Particle Physics and the Early Universe	500	6
Quantum Field Theory	500	6

¹ The courses Quantum Theory and Statistical Physics are given in a 6 EC variant (QT a, SP a), and a 9 EC variant (QT a+b, SP a+b).

² The course Topics in Theoretical Physics will not be offered in 2014-15. The content of the course varies from year to year. The course has an interactive format including presentations by the participating students.

³ A maximum of one Master course can be taken anywhere at Leiden University.

⁴ This course consists of a number of modules which are offered during the two years of the programme.

Quantum Theory a ¹	400	6
Quantum Theory a + b ¹	400	9
Statistical Physics a ¹	400	6
Statistical Physics a + b ¹	400	9
Theoretical Biophysics	500	6
Theoretical Cosmology	500	3
Theory of Condensed Matter	500	9
Theory of General Relativity	400	6
Topics in Theoretical Physics ²	400	6

The course Topics in Theoretical Physics will not be offered in 2014-15. It can be substituted by another Master course from the course list of Theoretical Physics. For the optional Master courses, a choice can also be made from the courses in the MSc programme in Mathematics. Note that not each of the Master Courses in Theoretical Physics is given every academic year and that also the offer of courses may change.

Specialisation

Research in Physics, Biological and Soft Matter Physics

Description

Research on Biological Physics within LION aims to understand biological processes in their natural context, which is cells and tissue. The teaching program will give the student the solid background to successfully operate in research that is at the interface of the medical, biological and physical sciences. Soft Matter physics concentrates on the physics of a wide range of soft materials, spanning from the microscopic interactions and assembly of colloids and polymers to the macroscopic behaviour of granular media, the physics of folding and metamaterials.

Qualifications for admission

Students from any university in the Netherlands with a BSc degree in Physics or Astronomy will be admitted to the programme. For all other (international) candidates, the Board of Admissions will judge the equivalence of their previous training to these BSc degrees. The choice in elective courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate.

¹ The courses Quantum Theory and Statistical Physics are given in a 6 EC variant (QT a, SP a), and a 9 EC variant (QT a+b, SP a+b).

² The course Topics in Theoretical Physics will not be offered in 2014-15. The content of the course varies from year to year. The course has an interactive format including presentations by the participating students.

Programme

	Level	EC
Quantum Theory a ¹	400	6
Statistical Physics a ¹	400	6
Courses from the Theoretical Physics courses on offer	400-600	6
Optional master courses from the MSc Physics programme ²	400-600	40
Academic and Professional Skills ³	400	2
Research project in Physics 1 (with Master thesis and oral presentation) ⁴	600	24
Research project in Physics 2 (with Master thesis and oral presentation)	600	36

All research projects are performed under responsibility of a LION staff member. One project can be carried out outside LION.

Specialisation

Research in Physics, Quantum Matter and Optics

Description

This specialisation offers comprehensive coverage of major current research themes in Condensed Matter physics, as well as the development of novel scanning probe techniques based on atomic force and scanning tunnelling microscopy. Among the research themes are Quantum Optics, Photon-Matter Interactions, Molecular Electronics, Oxide Electronics, and Superconductivity.

Qualifications for admission

Students from any university in the Netherlands with a BSc degree in Physics or Astronomy will be admitted to the programme. For all other (international) candidates, the Board of Admissions will judge the equivalence of their previous training to these BSc degrees. The choice in elective courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate.

¹ The courses Quantum Theory and Statistical Physics are given in a 6 EC variant (QT a, SP a), and a 9 EC variant (QT a+b, SP a+b). In both cases the 9 EC variant can be taken as partial fulfillment of the requirement for courses from the Theoretical Physics courses on offer.

² A maximum of one Master course of 6 EC can be taken anywhere at Leiden University.

³ This course consists of a number of modules which are offered during the two years of the programme.

⁴ A research project of 36 EC consists of 30 EC experimental work, a Master thesis of 5 EC, and an oral presentation of 1 EC. Smaller projects consist of the same components, proportionally scaled.

Programme

	Level	EC
Quantum Theory a ¹	400	6
Statistical Physics a ¹	400	6
Courses from the Theoretical Physics courses on offer	400-600	6
Optional master courses from the MSc Physics programme ²	400-600	40
Academic and Professional Skills ³	400	2
Research project in Physics 1 (with Master thesis and oral presentation) ⁴	600	24
Research project in Physics 2 (with Master thesis and oral presentation)	600	36

All research projects are performed under responsibility of a LION staff member. One project can be carried out outside LION.

Course List; Biological and Soft Matter Physics / Quantum Matter and Optics

	Level	EC
Advanced Biophysics	500	6
Basics of Electron Paramagnetic Resonance	500	3
Computational Physics	400	6
Entrepreneurship for Physicists	400	3
Introduction to Astroparticle Physics	400	6
Mechanical Metamaterials	400	3
Modern Classical Optics	400	6
Molecular Electronics	500	6
Quantum Optics	400	6
Signal Detection and Noise	300	6
Single Molecule Optics	500	6
Superconductivity	500	3
Surface Science	500	6

Note that not each of the Master Courses in Physics is given every academic year and that also the offer of courses may change.

¹ The courses Quantum Theory and Statistical Physics are given in a 6 EC variant (QT a, SP a), and a 9 EC variant (QT a+b, SP a+b). In both cases the 9 EC variant can be taken as partial fulfillment of the requirement for courses from the Theoretical Physics courses on offer.

² A maximum of one Master course of 6 EC can be taken anywhere at Leiden University.

³ This course consists of a number of modules which are offered during the two years of the programme.

⁴ A research project of 36 EC consists of 30 EC experimental work, a Master thesis of 5 EC, and an oral presentation of 1 EC. Smaller projects consist of the same components, proportionally scaled.

Specialisation

Research in Physics, cosmology

Description

The Cosmology specialisation is positioned at the interface between Theoretical Physics and Observational Astronomy. Characteristic elements of the specialisation are theory, data handling, and numerical simulations. It prepares the student for scientific research towards the PhD in a range of topics, but the master will also be well-equipped for industrial research or other problem-solving tasks that demand strong analytical and computational skills.

Qualifications for admission

Students from any university in the Netherlands with a BSc degree in Physics or Astronomy will be admitted to the programme. Similar to the Research in Theoretical Physics specialisation, in-depth knowledge is required of undergraduate courses with theoretical and mathematical emphasis: quantum physics, electrodynamics, statistical physics, and complex analysis. Also prerequisite is the Leiden Bachelor course on Physics of Elementary Particles (Fysica van Elementaire Deeltjes), or a clear equivalent. The Bachelor course Relativistic Electrodynamics (Relativistische Elektrodynamica) is strongly advised. For all other (international) candidates, the Board of Admissions will judge the equivalence of their previous training to these BSc degrees. The choice in elective courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate.

Programme

	Level	EC
Large Scale Structure and Galaxy Formation	500	6
Origin and Evolution of the Universe	500	6
Particle Physics and the Early Universe	500	6
Quantum Theory a ¹	400	6
Theory of General Relativity	400	6
Optional master courses from the Cosmology course list ²	400-500	9
Optional master courses from the MSc Physics programme	400-500	19
Academic and Professional Skills ³	400	2
Research project in Cosmology 1 (with Master thesis and oral presentation)	500	24
Research project in Cosmology 2 (Master's project) (with Master thesis and oral presentation)	600	36

Course List; Cosmology

	Level	EC
Black Holes and Gravitational Waves	500	3
Computational Astrophysics	400	6
Databases and Data Mining	500	3
Effective Field Theory	500	3
Observational Cosmology	400	3
Theoretical Cosmology	500	3

¹ The course Quantum Theory is given in a 6 EC variant (QT a), and a 9 EC variant (QT a+b).

² A maximum of one master course of 6 EC can be taken anywhere at Leiden University.

³ This course consists of a number of modules which are offered during the two years of the programme.

For the optional Master courses, a choice can also be made from courses in the MSc programme Astronomy. Note that not each of the Master Courses in Cosmology is given each academic year and that also the offer of courses may change.

Specialisation

Research in Physics, pre-PhD ('Casimir')

Description

The 'Casimir pre-PhD' specialisation is offered under the auspices of the Casimir Research School, a joint undertaking of the Leiden Institute of Physics (LION), and various departments at Delft University of Technology. It prepares the student for scientific research in a PhD position within the Casimir Research School, or elsewhere, and therefore puts strong emphasis on working in a research environment. The research within Casimir has a strong focus in the nanosciences and is grouped in the following themes : *Molecular Biophysics, Physics of Nanostructures, Quantum Matter and Functional Materials, Quantum Information and Quantum Optics, Universe Physics; theory and instrumentation, and Dynamic Complex Systems.*

The programme follows a strict schedule, in which the first year is devoted to laying a theoretical basis, and the second year to research and study projects, including the writing of a research proposal. The study projects are a special characteristic of the programme, specifically aiming at broadening the research perspective of the student. Conditions exist for admission into the specialisation, as well as for admission into the second year.

Qualifications for admission

The Casimir prePhD specialisation can be followed through selection only. Students admitted to the Physics Programme can apply during the first semester of their studies through the Casimir specialisation coordinator, and are selected on the basis of (i) their academic track record (including time to diploma) during the BSc studies and (ii) the results in the first semester. A grade point average of 7.5 is required, although exceptional circumstances can be taken in consideration. The program starts in the second semester. Admission to the second year is on the condition that all courses of the first year (60 EC) have been successfully completed. Students who are not admitted to the second year can continue in one of the other specialisations of the Physics Master. Students who are declined either after the first semester or after the first year can continue with the regular programme without incurring delays.

Programme

	Level	EC
Quantum Theory a ¹	400	6
Statistical Physics a ¹	400	6
Course from the list 'Foundational'	400-500	12
Courses from the list 'Topical'	400-500	12
Courses from the list 'Methods'	400-500	6
Optional Master courses in Physics	400-500	16
Academic and Professional Skills ²	400	2
Research project in Physics (with Master thesis and oral presentation)	600	36
Study projects and Writing Research Proposal	500	24

In the second year of the programme, students will be given the opportunity to attend a Summer School at the start of the year. Research project and study projects are also guided by a strict timeline. The Research project starts in September and finishes in February. The two study projects (8 EC each) are to be carried out in different groups, and in a different group than where the Research project took place, and have to be carried out between March and the end of May. Writing a research proposal is the last item in the programme. For a limited number of students within this specialisation, a PhD position will be guaranteed. Details can be found on the website of the Casimir Research School.

Course List; Casimir pre-PhD

<i>Foundational courses</i>	Level	EC	
Advanced Biophysics	500	6	(L)
Advanced Electrodynamics	400	6	(D)
Continuum Physics	400	6	(D)
Effective Field Theory	500	3	(L)
Quantum Field Theory	500	6	(L)
Quantum Theory a + b ³	400	9	(L)
Statistical Physics a + b ¹	400	9	(L)
Theory of Condensed Matter	500	9	(L)
Theory of General Relativity	400	6	(L)
Topics in Theoretical Physics	400	9	(L)
 <i>Topical Courses</i>	 Level	 EC	
Biophysics	400	6	(D)
Complex Networks	400	6	(L)
Quantum Optics	400	6	(L)
Evolution and Engineering of living systems	500	6	(D)
Introduction to Astroparticle Physics	400	6	(L)
Mechanical Metamaterials	400	3	(L)
Mesoscopic Physics	400	6	(D)
Molecular Electronics	500	6	(L/D)
Modern Classical Optics	400	6	(L)

¹ The courses Quantum Theory and Statistical Physics are given in a 6 EC variant (QT a, SP a), and a 9 EC variant (QT a+b, SP a+b).

² This course consists of a number of modules which are offered during the two years of the programme.

³ The courses Quantum Theory and Statistical Physics are given in a 6 EC variant (QT a, SP a), and a 9 EC variant (QT a+b, SP a+b).

Physics of Semiconductor Nanodevices	400	6	(D)
Quantum Information Processing	500	6	(D)
Quantum Electronics and Lasers	500	6	(D)
Single Molecule Optics	500	6	(L)
Surface Physics	500	6	(L)
Superconductivity	400	3	(L)
The Origins of Life	500	6	(D)
Theoretical Biophysics	500	6	(L)
<i>Methods</i>	Level	EC	
Basics of Electron Paramagnetic Resonance	500	3	(L)
Computational Physics/Scientific Computing	400	6	(L/D)
Nanotechnology	400	6	(D)

Courses given in Leiden are denoted (L), courses given in Delft are denoted (D). Electives can be chosen from the full list, irrespective of the location. Note that not each of the Master Courses is given each academic year and that also the offer of courses may change.

MSc Chemistry

CROHO-number 66857

The Leiden Institute of Chemistry (LIC) forms the basis for research and collaborations of the Leiden chemistry and life sciences groups. The two research areas in the LIC are *Chemical Biology* and *Energy & Sustainability*. The LIC offers four specialisations of an MSc programme, each with a focus on one of these major research areas. The four specialisations are: Research in Chemistry (CHEM), Science-Based Business (SBB), Science Communication & Society (SCS) and Education (EDU).

Aim of each programme is to train the student as an independent researcher, and to develop the necessary skills and proficiency to advance his/her career. Students with an MSc degree in Chemistry are admissible to a PhD programme.

The duration of each specialisation is two years (120 EC); a general overview of the content of the four specialisations is given in Table 1. Students who complete the programme receive the degree Master of Science in Chemistry, with specification of the specialisation and research area.

All specialisations have the same Director, the same Board of Examiners and the same Department Teaching Committee.

Table 1: Overview of the programmes of the four MSc Chemistry specialisations

Specialisation	CHEM	EDU	SCS	SBB
Internship	60	30	30	30
Compulsory courses in research area	24	24 ¹	24	24
Essay & Colloquium	6	-	-	-
Free electives ²	30	36 / 6 ³	26	26
EDU/SCS/SBB components	-	30 / 60 ³	40	40
Total	120	120	120	120

Admission procedure

Students from any university in The Netherlands with a BSc degree in Chemistry or with a BSc Major in Chemistry will be admitted to the programme. All other (international) candidates, such as students with a degree related to Chemistry, HBO Bachelors and foreign students have to apply for admission. As a guideline, the HBO-diploma has to be obtained within four years and with an average final mark above 7.5

The Board of Admissions will judge the qualifications of the applicant on the basis of the curriculum and grades of his/her previous training. The admission process may include an interview with the Board of Admissions. Foreign applicants must provide proof of proficiency in English (IELTS level ≥ 6.5). The applicants for the EDU and SCS specialisations must provide proof of proficiency in Dutch. Admission is possible throughout the year, but we advise (foreign) students to start in September or February.

¹ Students in the EDU specialisation are advised to choose from both research areas, to obtain a broader knowledge of chemistry.

² The choice in the free electives is restricted to the boundaries specified here. A maximum of 20 EC can be used for extension of the internships.

³ If the student has taken a minor in Education (tweedegraadsbevoegdheid) of 30 EC in the BSc programme, only 30 EC are necessary in the MSc programme to obtain the "eerstegraadsbevoegdheid"; then 30 EC free electives are added to the programme of the MSc Chemistry.

Programme

Each student composes his/her own study programme in consent with the mentor, who is a Principal Investigator of the LIC. The mentor is the supervisor of the major research internship in one of the research areas as chosen by the student. The mentor will coach the student from the admission throughout the MSc programme. The choice in elective courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate. The intended programme may be adjusted during the course of the MSc programme. The study coordinator administrates a copy of the individual study programme; it is used to keep track of the student's progress and forms the basis for the master portfolio. The master planner is updated by the student on a regular basis. It is accessible to the student, the mentor and the study coordinator. The mentor discusses the progress of the student at least every half year using the results documented in the planner. The study coordinator will mediate when the student encounters problems in the interaction with the mentor.

Description of the research areas

Chemical Biology research at the LIC is characterised by studying and influencing physiological processes at the molecular level. Fundamental biological problems are addressed using intrinsic chemical approaches and concepts. The driving force behind the Leiden *Chemical Biology* research is the ability to design functional molecules that can be used to investigate and influence biomolecular interactions and structures. The research is inspired by physiological processes that underlie human diseases. The ultimate goal is to contribute to human health through conceptually new methods for diagnosis, drug development and new therapies for diseases.

The *Energy & Sustainability* research at the LIC is focused on chemical reactions of importance to the sustainable and efficient production and storage of energy, as well as the subsequent usage of stored energy, on a fundamental level. The Leiden research on sustainable energy employs advanced spectroscopic techniques, nano-imaging, inorganic synthesis, and theoretical methods to elucidate the molecular processes that are at the basis of the conversion of solar energy to chemical energy. In addition, new catalysts, materials, and molecular and supramolecular systems are being developed and investigated, especially for cyclic redox chemistry of the hydrogen-oxygen cycle, with attention for the reversible storage of hydrogen, and for the carbon cycle, in which the sustainable and reversible conversion of carbon dioxide into a liquid carbon-rich fuel is a central challenge.

Programmes of the specialisations

The programmes of the specialisations Science-Based Business, Science Communication & Society and Education are described separately in this Appendix.

Specialisation – Research in Chemistry (CHEM)

The research specialisation offers the student the opportunity to spend two full years on training and specialisation to become an independent and creative researcher. The MSc students will become a member and colleague in one of the research groups in the LIC. The student will develop her/his individual MSc programme together with the mentor. The majority of the students with an MSc in Research in Chemistry will continue their career in a PhD position.

The Research in Chemistry programme (CHEM) consists of three parts: the research internship (60 EC), the compulsory courses (30 EC) and the elective courses (30 EC). A general overview of the programme is given in Table 1.

The (major) research internship is carried out in a LIC research group in one of the research areas (*Chemical Biology, Energy & Sustainability*) and includes a presentation for the research group and a written report (the master thesis). The major research internship is concluded with a presentation for an independent jury of two staff members, as well as interested students and staff members of the LIC (Thesis Talk). All students attend at least 10 Thesis Talks during their MSc program. The research internship may be split into two internships: the major and minor internship. The major internship is limited to 40-60 EC and a minor internship must comprise at least 20 EC. The minor and major internship project may be related and this may be reflected in a combined master thesis. In consent with the mentor the minor internship can be carried out in another research area, another institute (within the Netherlands or abroad), or in a company. Prior approval of the Board of Examiners is required for an internship outside the institute. A staff member of the LIC has the final responsibility for the grading of the internship report of research not carried out in the LIC.

The compulsory theoretical component comprises a selection of four core courses (24 EC) and a literature essay with colloquium (6 EC). All students attend at least 10 colloquia during their MSc program. The core courses are chosen within the research area. A list of the core courses offered by the two research areas is given in Table 2.

The elective component consists of a free choice of theoretical courses (30 EC). Alternatively, a maximum of 20 EC can be used to extend the research internships. The mentor may limit the choice in elective courses by the need to adapt the programme to the present knowledge of the student. Students can choose their electives from the list of core courses within or outside their research area, from the list of elective courses, the MSc courses offered in a Science Faculty of any Dutch university of level 400 or higher, or level 400 courses from the BSc MST and LST programmes provided that these were not part of the student's earlier studies. All other electives have to be approved by the Board of Examiners.

Table 2: Core courses organised by the LIC research areas *Chemical Biology (CB)* and *Energy & Sustainability (ES)*. All courses are at level 400 or 500 and encompass 6 EC.

	yearly	research area
Modern Organic Chemistry	yes	CB
Biomolecular Structures	yes	CB
Molecular biology	yes	CB
Supramolecular chemistry	yes	CB
Advanced Medicinal Chemistry	yes	CB
Reactivity in Organic Chemistry	yes	CB
Cell Biology	yes	CB
Chemical Biology	yes	CB
Modern Quantum Chemistry ¹	yes	ES
Spectroscopy ¹	yes	ES
Organometallic chemistry & homogeneous catalysis	yes	ES
Electrochemistry & Bioelectrochemistry	yes	ES
Photochemistry	yes	ES
Quantum dynamics of chemical reactions	biennial	ES
Dynamics of molecule-surface reactions	biennial	ES

¹ Modern Quantum Chemistry and Spectroscopy are compulsory components for MSc students in the research area Energy & Sustainability (ES).

MSc Bio-Pharmaceutical Sciences

CROHO-number 60207

The aim of the MSc programme Bio-Pharmaceutical Sciences (BPS), organised by the Leiden Academic Centre for Drug Research (LACDR) of Leiden University, is to train students for a research career in drug research and development, not for a career as a (public) pharmacist. The MSc programme Bio-Pharmaceutical Sciences offers nine specialisations. Five of these are research specialisations corresponding to major research themes at the LACDR. The remaining four specialisations combine the research component of the MSc programme with training in Science-Based Business (SBB), Science Communication & Society (SCS), Education (EDU), and Industrial Pharmacy (QP).

The duration of each programme is two years (120 EC). Students who complete the programme receive the degree Master of Science in Bio-Pharmaceutical Sciences, with specification of the specialisation, if applicable. Details are provided below. All specialisations have the same Director, the same Board of Examiners, and the same Department Teaching Committee. A Board of Admissions will advise on admissions.

Admission procedure

Candidates with a BSc degree or equivalent can apply for admission. The admission guidelines are given below for each specialisation. The admission process may include an interview with the Board of Admissions. Foreign applicants must provide proof of proficiency in English (IELTS level: final score ≥ 6.5 , with a minimum of 6.0 for each of the components Listening, Reading, Writing and Speaking). Admission is possible throughout the year, but we advise foreign students to start in September or February. Further information is available on the website www.mastersinleiden.nl

Programmes of the specialisations

The aim of each programme is to train the student as an independent researcher in Bio-Pharmaceutical Sciences, and to develop the necessary skills and proficiency to advance his/her career.

The programmes of the Science-Based Business (SBB), Science Communication & Society (SCS) and Education (EDU) specialisations that can be combined with a Bio-Pharmaceutical Sciences research component in one of the areas described below are described separately in this appendix.

Specialisation Medicinal Chemistry

Description

The MSc programme Medicinal Chemistry (drug design and molecular modelling) trains for junior drug researchers, and prepares students for a career in medicinal chemistry.

Qualifications for admission

Students from any university in the Netherlands with a BSc degree in Bio-Pharmaceutical Sciences or Pharmaceutical Sciences will be admitted to the programme.

For all other (international) candidates, the Board of Admissions will judge whether their previous training is equivalent to these BSc degrees. Notably, applicants with a BSc (or equivalent) in Chemistry, Life Science and Technology, as well as HBO Bachelors (BSc in Applied Sciences) in Chemistry or with an equivalent BSc will be considered.

As a guideline, the HBO Bachelor has to be obtained within four years with an average final mark above 7.5. In addition, the research project that was included in the HBO-programme should have been conducted at a university or a university medical centre and should have been assessed with a mark above 8.0 (marks according to the Dutch grading scale).

The choice in optional courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate.

Programme

The programme contains two research periods (52 and 36 EC), and compulsory and optional programme components (32 EC):

	Level	EC
Lecture series 1 (in BPS)	500	4
Lecture series 2 (in BPS)	500	4
Research project 1, in Medicinal Chemistry		
• Practical Work	600	45
• Thesis	600	5
• Oral presentation	500	2
Research project 2		
• Practical Work	600	31
• Thesis	600	5
Literature study plus thesis	500	7
Course Scientific Conduct	500	1
20 Colloquia and Lectures	500	1
Optional courses or traineeships	≥400 (max 12 EC <400)	15

Research project 2

This research project may be conducted within the Faculty of Science (preferably in another discipline of BPS) or at the Centre for Human Drug Research, Leiden University Medical Center, other University Medical Centers or research institutes, or at an R&D department of a Pharmaceutical company. Students are encouraged to go abroad for Research project 2.

Specialisation Analytical Biosciences

Description

The MSc programme Analytical Biosciences (analytical chemistry focussing on hyphenated bio-analytical strategies including proteomics) trains for junior drug researchers, and prepares students for a career in analytical chemistry.

Qualifications for admission

Students from any university in the Netherlands with a BSc degree in Bio-Pharmaceutical Sciences or Pharmaceutical Sciences will be admitted to the programme.

For all other (international) candidates, the Board of Admissions will judge whether their previous training is equivalent to these BSc degrees. Notably, applicants with a BSc (or equivalent) in Chemistry, Life Science and Technology, as well as HBO Bachelors (BSc in Applied Sciences) in Chemistry or with an equivalent BSc will be considered.

As a guideline, the HBO Bachelor has to be obtained within four years with an average final mark above 7.5. In addition, the research project that was included in the HBO programme should have been conducted at a university or a university medical centre and should have been assessed with a mark above 8.0 (marks according to the Dutch grading scale).

The choice in optional courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate.

Programme

The programme contains two research periods (52 and 36 EC), and compulsory and optional programme components (32 EC):

	Level	EC
Lecture series 1 (in BPS)	500	4
Lecture series 2 (in BPS)	500	4
Research project 1, in Analytical Biosciences		
• Practical Work	600	45
• Thesis	600	5
• Oral presentation	500	2
Research project 2		
• Practical Work	600	31
• Thesis	600	5
Literature study plus thesis	500	7
Course Scientific Conduct	500	1
20 Colloquia and Lectures	500	1
Optional courses or traineeships	≥400 (max 12 EC <400)	15

Research project 2

This research project may be conducted within the Faculty of Science (preferably in another discipline of BPS) or at the Centre for Human Drug Research, Leiden University Medical Center, other University Medical Centers or research institutes, or at an R&D department of a Pharmaceutical company. Students are encouraged to go abroad for Research project 2.

Specialisation Pharmacology

Description

The MSc programme Pharmacology (drug transport and disposition; pharmacokinetics/pharmacodynamics; Blood-Brain-Barrier; clinical pharmacology) trains for junior drug researchers, and prepares students for a career in pharmacology.

Qualifications for admission

Students from any university in the Netherlands with a BSc degree in Bio-Pharmaceutical Sciences or Pharmaceutical Sciences will be admitted to the programme.

For all other (international) candidates, the Board of Admissions will judge whether their previous training is equivalent to these BSc degrees. Notably, applicants with a BSc (or equivalent) in Biology or Biomedical Sciences, as well as HBO Bachelors (BSc in Applied Sciences) in Biomedical Sciences or with an equivalent BSc will be considered.

As a guideline, the HBO Bachelor has to be obtained within four years with an average final mark above 7.5. In addition, the research project that was included in the HBO programme should have been conducted at a university or a university medical centre and should have been assessed with a mark above 8.0 (marks according to the Dutch grading scale).

The choice in optional courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate.

Programme

The programme contains two research periods (52 and 36 EC), and compulsory and optional programme components (32EC):

	Level	EC
Lecture series 1 (in BPS)	500	4
Lecture series 2 (in BPS)	500	4
Research project 1, in Pharmacology <i>or</i> Clinical Pharmacology		
• Practical Work	600	45
• Thesis	600	5
• Oral presentation	500	2
Research project 2		
• Practical Work	600	31
• Thesis	600	5
Literature study plus thesis	500	7
Course Scientific Conduct	500	1
20 Colloquia and Lectures	500	1
Optional courses or traineeships	≥400 (max 12 EC <400)	15

Research project 2

This research project may be conducted within the Faculty of Science (preferably in another discipline of BPS) or at the Centre for Human Drug Research, Leiden University Medical Center, other University Medical Centers or research institutes, or at an R&D department of a Pharmaceutical company. Students are encouraged to go abroad for Research project 2.

Specialisation

Drug Delivery Technology and Biopharmaceutics

Description

The MSc programme Drug Delivery Technology and Biopharmaceutics (drug delivery and formulation research; drug target finding and gene modulation in cardiovascular disease) trains for junior drug researchers, and prepares students for a career in drug delivery technology and/or drug target finding and therapeutic gene modulation.

Qualifications for admission

Students from any university in the Netherlands with a BSc degree in Bio-Pharmaceutical Sciences or Pharmaceutical Sciences will be admitted to the programme.

For all other (international) candidates, the Board of Admissions will judge whether their previous training is equivalent to these BSc degrees. Notably, applicants with a BSc (or equivalent) in Biology, Biomedical Sciences, Chemistry, Life Science and Technology, as well as HBO Bachelors (BSc in Applied Sciences) in Chemistry or Biomedical Sciences or with an equivalent BSc will be considered.

As a guideline, the HBO Bachelor has to be obtained within four years with an average final mark above 7.5. In addition, the research project that was included in the HBO programme should have been conducted at a university or a university medical centre and should have been assessed with a mark above 8.0 (marks according to the Dutch grading scale).

The choice in optional courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate.

Programme

The programme contains two research periods (52 and 36 EC), and compulsory and optional programme components (32 EC):

	Level	EC
Lecture series 1 (in BPS)	500	4
Lecture series 2 (in BPS)	500	4
Research project 1, in Drug Delivery Technology <i>or</i> Biopharmaceutics		
• Practical Work	600	45
• Thesis	600	5
• Oral presentation	500	2
Research project 2		
• Practical Work	600	31
• Thesis	600	5
Literature study plus thesis	500	7
Course Scientific Conduct	500	1
20 Colloquia and Lectures	500	1
Optional courses or traineeships	≥400 (max 12 EC <400)	15

Research project 2

This research project may be conducted within the Faculty of Science (preferably in another discipline of BPS) or at the Centre for Human Drug Research, Leiden University Medical Center, other University Medical Centers or research institutes, or at an R&D department of a Pharmaceutical company. Students are encouraged to go abroad for Research project 2.

Specialisation Toxicology

Description

The MSc programme Toxicology (cellular and molecular mechanisms of toxicity) trains for junior drug researchers, and prepares students for a career in toxicology.

Qualifications for admission

Students from any university in the Netherlands with a BSc degree in Bio-Pharmaceutical Sciences, or Pharmaceutical Sciences will be admitted to the programme.

For all other (international) candidates, the Board of Admissions will judge whether their previous training is equivalent to these BSc degrees. Notably, applicants with a BSc (or equivalent) in Biomedical Sciences, Chemistry, Life Science and Technology, as well as HBO Bachelors (BSc in Applied Sciences) in Chemistry or Biomedical Sciences or with an equivalent BSc will be considered.

As a guideline, the HBO Bachelor has to be obtained within four years with an average final mark above 7.5. In addition, the research project that was included in the HBO programme should have been conducted at a university or a university medical centre and should have been assessed with a mark above 8.0 (marks according to the Dutch grading scale).

The choice in optional courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate.

Programme

The programme contains two research periods (52 and 36 EC), and compulsory and optional programme components (32 EC):

	Level	EC
Lecture series 1 (in BPS)	500	4
Lecture series 2 (in BPS)	500	4
Research project 1, in Toxicology		
• Practical Work	600	45
• Thesis	600	5
• Oral presentation	500	2
Research project 2		
• Practical Work	600	31
• Thesis	600	5
Literature study plus thesis	500	7
Course Scientific Conduct	500	1
20 Colloquia and Lectures	500	1
Optional courses or traineeships	≥400 (max 12 EC <400)	15

Research project 2

This research project may be conducted within the Faculty of Science (preferably in another discipline of BPS) or at the Centre for Human Drug Research, Leiden University Medical Center, other University Medical Centers or research institutes, or at an R&D department of a Pharmaceutical company. Students are encouraged to go abroad for Research project 2.

Specialisation Industrial Pharmacy

Description

The MSc programme Industrial Pharmacy trains students in safety and quality control in the production of medicinal products, and prepares students for a career in Quality Assurance and Quality Control in the biotechnological and pharmaceutical industry.

Qualifications for admission

Students from any university in the Netherlands with a BSc degree in Bio-Pharmaceutical Sciences, Pharmaceutical Sciences or Pharmacy with an average grade of 7.5 or higher (grades according to the Dutch grading scale) will be considered for admittance to this specialisation of the programme.

The Board of Admissions will judge the candidate's personal skills (e.g. awareness of responsibility, accuracy, communication skills, methodological approach when analysing complex problems, and motivation) for qualification to the specialisation. A final decision on admission to the specialisation Industrial Pharmacy will be made after completion of at least half of (≥ 22 EC) of the research project at one of the Divisions of the LACDR. Admission to the programme is limited to 2 students.

Programme

The programme contains a research project of 50 EC (consisting of 43 EC for practical work, 5 EC for writing a thesis and 2 EC for giving an oral presentation) and other compulsory components (70 EC):

	Level	EC
Lecture series 1 (in BPS)	500	4
Lecture series 2 (in BPS)	500	4
Research project 1, at one of the Divisions of the LACDR		
• Practical Work	600	43
• Thesis	600	5
• Oral presentation	500	2
Course Scientific Conduct	500	1
20 Colloquia and Lectures	500	1
Internship Quality Control/Quality Assurance, in a Pharmaceutical Company under supervision of a Qualified Person (QP) and an examiner of the LACDR, including Practical Work, Thesis and Oral Presentation	600	37
Essay Quality Control/Quality Assurance	600	7
Course Basic Good Manufacturing Practices (GMP)	NA	1
Course Ethics in Quality Control Practices	500	1
Course Legislation of Production of Medicinal Products	600	2
Course Sterile Manufacturing in Practice	600	4

Course Quality Management in Pharma and Biotech¹

• the Role of the Qualified Person	500	2
• Drug development: from 'Quality by Design' to Clinical Studies	600	2
• Sterile Manufacturing	600	2
• Quality and Safety for the Manufacturing of Biopharmaceuticals	600	2

The programme of the specialisation Industrial Pharmacy is under development and may be subject to change.

¹ PAOFarmacie: Netherlands Centre for Post-Academic Education in Pharmacy

MSc Biology

CROHO-number 66860

The Institute Biology Leiden (IBL) of Leiden University offers an attractive and varied MSc programme. Students can follow a general Biology programme or choose between four research specialisations '*Animal Biology and Disease Models (AB)*, '*Microbial Biotechnology and Health (MB)*, '*Plant Sciences and Natural Products (PS)*, and '*Evolution, Biodiversity and Conservation (EBC)*', which reflect the major themes of biological research at Leiden University. A special feature of the '*Evolution, Biodiversity and Conservation (EBC)*' programme is its close link with the unique biodiversity research cluster in Leiden consisting of the Institute of Environmental Sciences (CML), the Hortus Botanicus, and the Naturalis Biodiversity Center (the latter hosts both the national zoological and botanical collections). In addition to the four research specialisations, three additional specialisations combine research programmes in biology with training in Science-Based Business (SBB), Science Communication & Society (SCS) or Education.

The duration of the programme is two years (120 EC). Students who complete the programme receive the degree Master of Science in Biology (MSc in Biology) with specification of the specialisation, if applicable. The degree provides graduates with the academic training and research skills required to pursue a scientific or science-related career. All specialisations have the same Director of Education, Department Teaching Committee and Board of Examiners. A Board of Admissions advises on admissions.

Admission

Students with a BSc degree in Biology that is from another university than Leiden University need to apply for admission. Students with a BSc degree in other Natural Sciences, Life Sciences, Mathematics, Biomedical Sciences or from a biology-related University of Applied Sciences (HBO) can also apply for admission.

For HBO bachelors, and for candidates with degrees from universities abroad and candidates with a BSc degree in any of the other Natural Sciences, Life Sciences, or Biomedical Sciences, the Board of Admissions will evaluate how the previous training matches that of the Dutch bachelors in Biology. Where this results in admission, this may be under the condition of a specific additional course load. Where possible, deficiencies may be remedied by including some optional elements of the MSc programme as part of the study programme.

The admission process may include an interview with the Board of Admissions. The admission guidelines for each specific specialisation are given in more detail below where they differ from these general admission qualifications. Foreign applicants must provide proof of proficiency in English (IELST \geq 6.5). The score on each subtest (reading, writing, speaking) has to be at least 6.0

Start of the programme

Students may enter the programme in September or February. However, they are strongly encouraged to start in September when a general introduction to the master programme and compulsory theoretical courses are scheduled.

Specialisation **Animal Biology and Disease Models**

Description

The Master specialisation Animal Biology and Disease Models offers a research-oriented education in animal biology with a strong focus on the generation of fundamental scientific knowledge that can lead to the improvement of human health. Important aspects of animal development and the interaction of animals with the environment can be studied at different often integrated levels ranging from the molecular, genetic and cellular levels to the organismal and population levels.

A major part of the master training is actively taking part in a running research project within the theme of the specialisation at the Institute Biology Leiden or at other research groups of the Faculty of Science or the at the Leiden University Medical Center (LUMC). There are also many possibilities for external projects at other universities or research institutes in the Netherlands or abroad.

Programme (120 EC)

The MSc specialisation consists of:

- a theoretical part (30-60 EC)
- one or more research projects (60-90 EC).

The programme includes several compulsory components, mostly at the start and the end of the programme, and can be expanded with a wide choice of elective elements. The mandatory components in the 1st semester aim to provide students with the theoretical and practical background needed for an efficient start of the Research Project at the end of this semester. The Research Projects are the actual core of the MSc programme. Students will be member of a research group of their choice and work full time on a specific project. Each project will be finished with an MSc thesis written in the form of a manuscript for an international scientific journal. At least one but preferably two Research Projects are part of the study programme.

The Specialisation Research Project has to be done within the theme of the specialisation at the Institute Biology Leiden, at other departments of the Faculty of Science or at the Leiden University Medical Center. All Research Projects require prior approval by the Board of Examiners through approval of the individual study plan of a student and approval of the research agreement.

Compulsory components:

The compulsory theoretical components consist of at least 30 EC, and the minimum time to be spent on research projects is 60 EC. The specialisation Research Project should be minimally 36 EC, and a second Research Project should be at least 30 EC.

	Level	EC
Orientation on Animal Biology and Disease Models ¹	400	3
Genomic Architecture	400	6
Advanced Statistics	500	3
Top Lectures in MCB or EBC	500	3
Book exam	500	3
Course of choice	500/600	
<i>At least 1 of the following courses:</i>		
• Mechanisms of Disease	500	6
• Development and Evolution	500	6
Research Project(s) (at least 36 EC within the specialisation)	600	min. 60
Electives		max. 30

Electives/Optional elements

The optional part of the programme can consist of either additional courses or lectures, or an extension of the duration of a research project. A list of approved elective courses is available on the e-guide. For courses outside the Leiden University biology programme and for all research projects, prior approval of the Board of Examiners is required. Note: maximally 12 EC of optional theoretical elements of level < 400 are permitted and max 15 EC non-biology courses.

Approval of programme

The individual study programme consisting of choices of courses and one or two research projects must have prior approval of the Board of Examiners

Short description of the Courses

The Animal Biology and Disease Models study programme comprises several compulsory courses. The course *Orientation on Animal Biology* provides a state of the art overview of the scientific research and research methods used in the departments participating in this MSc specialisation. The course “*Genomic Architecture*” aims at training students to become “genome-enabled” biologists by giving an overview of the structure, function and evolution of genomes. Together with the Advanced Statistics course, and one of the two specialisation courses Mechanisms of Disease or Development and Evolution, this will prepare the students theoretically for their training in scientific research during the Research Project(s). The mandatory courses should preferably be successfully completed before starting with the rest of the program.

Another obligatory element in the AB specialisation is the Top lectures series. This course consists of 6 lectures by internationally leading scientists in fields relevant for the Animal Biology programme. Students prepare for the lectures by reading scientific papers, and by discussion of these papers with the speaker.

At the beginning of the second semester (in year 1 or 2) students prepare individually from an advanced text book for a specialised examination. Available book titles are provided in the electronic study guide (e-prospectus). A variety of additional courses from other MSc specialisations in Biology and from other Msc programmes at the Faculty of Science and LUMC can be chosen as electives. For details (description, literature, exam dates and further calendar events) about the different courses see the e-prospectus and Blackboard.

¹ The orientation course can be replaced by an Orientation Course from a different specialisation

Specialisation

Evolution, Biodiversity and Conservation

Description

Evolution, Biodiversity and Conservation is a research-oriented master specialisation in biological sciences at Leiden University that provides state of the art knowledge on subjects as ecology, evolutionary biology, biodiversity, environmental sciences and conservation.

It builds on the unique combination of biological institutes in Leiden joining forces: the Institute Biology Leiden (IBL), the Institute of Environmental Sciences (CML), and the Naturalis Biodiversity Center.

Programme (120 EC)

The MSc specialisation consists of:

- a theoretical part (30-60 EC)
- one or more research projects (60-90 EC).

The programme includes several compulsory components, mostly at the start and the end of the programme, and can be expanded with a wide choice of elective elements. The mandatory components in the 1st semester aim to provide students with the theoretical and practical background needed for an efficient start of the Research Project at the end of this semester. The Research Projects are the actual core of the MSc programme. Students will be member of a research group of their choice and work full time on a specific project. Each project will be finished with an MSc thesis written in the form of a manuscript for an international scientific journal. At least one but preferably two Research Projects are part of the study programme. The Specialisation Research Project has to be done in one of the IBL, CML or Naturalis departments that contribute to the chosen specialisation. Research projects can range from experimental studies on the molecular mechanisms of development or on animal behaviour to collection-based research on biodiversity or field projects in the Netherlands or elsewhere (e.g. terrestrial and marine studies in Southeast Asia). Students are encouraged to do an external project at an institute abroad. All Research Projects require prior approval by the Board of Examiners through approval of the individual study plan of a student and approval of the research agreement.

Compulsory components:

The compulsory theoretical components consist of at least 30 EC, and the minimum time to be spent on research projects is 60 EC. The specialisation Research Project should be minimally 36 EC, and a second Research Project should be at least 30 EC.

	Level	EC
Orientation on Evolution, Biodiversity and Conservation ¹	400	3
Genomic Architecture	400	6
Advanced Statistics	500	3
<i>At least 1 of the following courses:</i>		
• Conservation Biology	500	6
• Methods in biodiversity analysis	500	6
• Development & Evolution	500	6
Top Lectures in EBC or MCB	500	3
Book exam	500	3
Course of choice	500/600	6
Research Project(s) (at least 36 EC within the specialisation)	600	min. 60
Electives		max. 30

Electives/Optional elements:

The optional part of the programme can consist of either additional courses or lectures, or an extension of the duration of a research project. A list of approved elective courses is available on the e-guide. For courses outside the Leiden University biology programme and for all research projects, prior approval of the Board of Examiners is required. Note: maximally 12 EC of optional theoretical elements of level < 400 are permitted and max 15 EC non-biology courses.

Approval of programme

The individual study programme consisting of choices of courses and one or two research projects must have prior approval of the Board of Examiners

Short description of the Courses

Courses cover a broad range of relevant subjects and provide in-depth theoretical knowledge as well as training in practical skills and advanced research tools. The course *Orientation on Evolution Biodiversity and Conservation* provides a state of the art overview of the scientific research and research methods used in the departments participating in this MSc specialisation.

The course “*Genomic Architecture*” aims at training students to become “genome-enabled” biologists by giving an overview of the structure, function and evolution of genomes. In addition, students are trained in ‘*Advanced Statistics*’ and follow at least one specialised course providing students with an integrated picture on specific topics for their training in scientific research during the Research Project(s). For the *Top Lectures* course, internationally leading scientists in fields relevant for the programme are invited for special lectures and discussion with students.

At the beginning of the second semester (in year 1 or 2) students prepare individually from an advanced text book for a specialised examination. Available book titles are provided in the electronic study guide (e-prospectus). A variety of additional courses from other MSc specialisations in Biology and from other Msc programmes at the Faculty of Science and LUMC can be chosen as electives. For details (description, literature, exam dates and further calendar events) about the different courses see the e-prospectus and Blackboard.

¹ The orientation course can be replaced by an Orientation Course from a different specialisation

Specialisation

Microbial Biotechnology and Health

Description

The Master specialisation Microbial Biotechnology and Health offers a research-oriented education in microbiology with a strong focus on the generation of fundamental scientific knowledge that can lead to the improvement of micro-organisms as production platforms for valuable compounds such as food additives and antibiotics. Important aspects of the development and physiology of micro-organisms and their interaction with the environment can be studied at the molecular, genetic, physiological and cellular levels, often in an integrated manner. Training is provided in functional genomics, cellular imaging, transcriptomics, proteomics and metabolomics and insight is given in the potential and power of these techniques in microbiological research. Particular attention is paid to the implications of these techniques for biotechnology.

A major part of the master training is actively taking part in a running research project within the theme of the specialisation at the Institute Biology Leiden, other departments of the Faculty of Science, or the Leiden University Medical Center (LUMC). There are also possibilities for an external project at an institute abroad.

Admission

Specific admission requirements in addition to the previously formulated general admission qualifications: Theoretical and practical knowledge of molecular biology and microbiology at BSc level is required.

Programme (120 EC)

The MSc specialisation consists of:

- a theoretical part (30-60 EC)
- one or more research projects (60-90 EC).

The programme includes several compulsory components, mostly at the start and the end of the programme, and can be expanded with a wide choice of elective elements. The mandatory components in the 1st semester aim to provide students with the theoretical and practical background needed for an efficient start of the Research Project at the end of this semester. The Research Projects are the actual core of the MSc programme. Students will be member of a research group of their choice and work full time on a specific project. Each project will be finished with an MSc thesis written in the form of a manuscript for an international scientific journal. At least one but preferably two Research Projects are part of the study programme.

The Specialisation Research Project has to be done within the theme of the specialisation at the Institute Biology Leiden, at other departments of the Faculty of Science or at the Leiden University Medical Center. All Research Projects require prior approval by the Board of Examiners through approval of the individual study plan of a student and approval of the research agreement.

Compulsory components:

The compulsory theoretical components consist of at least 30 EC, and the minimum time to be spent on research projects is 60 EC. The specialisation Research Project should be minimally 36 EC, and a second Research Project should be at least 30 EC.

Level EC

	Level	EC
Orientation on Microbial Biotechnology and Health ¹	400	3
Genomic Architecture	400	6
Advanced Statistics	500	3
Global Regulatory Networks in Bacteria	500	6
Top Lectures in MCB	500	3
Book exam	500	3
Course of choice	500/600	6
Research Project(s) (at least 36 EC within the specialisation)	600	min. 60
Electives		max. 30

Electives/Optional elements

The optional part of the programme can consist of either additional courses or lectures, or an extension of the duration of a research project. A list of approved elective courses is available on the e-guide. For courses outside the LU biology programme and for all research projects, prior approval of the Board of Examiners is required. Note: maximally 12 EC of optional theoretical elements of level < 400 are permitted and max 15 EC non-biology courses.

Approval of programme

The individual study programme consisting of choices of courses and one or two research projects must have prior approval of the Board of Examiners

Short description of the Courses

The Microbial Biotechnology study programme comprises several compulsory courses. The course *Orientation on Microbial Biotechnology* provides a state of the art overview of the scientific research and research methods used in the departments participating in this MSc specialisation taken from presentations by group leaders and PhD students. The course "*Genomic Architecture*" aims at training students to become "genome-enabled" biologists by giving an overview of the structure, function and evolution of genomes. Together with the Advanced Statistics course, and the specialisation course Global Regulatory Networks in Bacteria, this will prepare the students theoretically for their training in scientific research during the Research Project(s).

Another obligatory element is the Top lectures series. This course consists of 6 lectures by internationally leading scientists in fields relevant for the Microbial Biotechnology programme. Students prepare for the lectures by reading scientific papers, and by discussion of these papers with the speaker.

At the beginning of the second semester (in year 1 or 2) students prepare individually from an advanced text book for a specialized examination. Available book titles are provided in the electronic study guide (e-prospectus). A variety of additional courses from other MSc specialisations in Biology and from other Msc programmes at the Faculty of Science and LUMC can be chosen as electives. For details (description, literature, exam dates and further calendar events) about the different courses see the e-prospectus and Blackboard.

¹ The orientation course can be replaced by an Orientation Course from a different specialisation

Specialisation **Plant Sciences and Natural Products**

Description

The Master specialisation Plant Sciences and Natural Products offers a research-oriented education in plant sciences with a strong focus on the generation of fundamental scientific knowledge that can lead to the improvement of crop quality and yield. Important aspects of plant development and the interaction of plants with the environment can be studied at different often integrated levels ranging from the molecular, genetic and cellular levels to organismal and population levels. It is also possible to study the production of plant natural products that are important for the food or pharmaceutical industries.

A major part of the master training is actively taking part in a running research project within the Plant Sciences and Natural Products research area at the Institute of Biology, the Faculty of Science, Naturalis Biodiversity Center or Institute of Environmental Sciences. There are also possibilities for external projects at other plant institutes in the Netherlands or abroad.

Programme (120 EC)

The MSc specialisation consists of:

- a theoretical part (30-60 EC)
- one or more research projects (60-90 EC).

The programme includes several compulsory components, mostly at the start of the programme, and can be expanded with a wide choice of elective elements. The mandatory components in the 1st semester aim to provide students with the theoretical and practical background needed for an efficient start of the specialisation Research Project at the end of this semester. The Research Projects are the actual core of the MSc programme. Students will be member of a research group of their choice and work full time on a specific project. Each project will be finished with an MSc thesis written in the form of a manuscript for an international scientific journal. At least one but preferably two Research Projects are part of the study programme.

The Specialisation Research Project has to be done within the Plant Sciences and Natural Products research area at the Institute Biology Leiden, the Faculty of Science, Naturalis Biodiversity Center or Institute of Environmental Sciences. All Research Projects require prior approval by the Board of Examiners through approval of the individual study plan of a student and approval of the research agreement.

Compulsory components:

The compulsory theoretical components consist of at least 30 EC, and the minimum time to be spent on research projects is 60 EC. The specialisation Research Project should be minimally 36 EC, and a second Research Project should be at least 30 EC.

	Level	EC
Orientation on Plant Sciences and Natural Products ¹	400	3
Genomic Architecture	400	6
Advanced Statistics	500	3
Top Lectures in EBC or MCB	500	3
Book exam	500	3
Course of choice	500/600	6
<i>At least 1 of the following courses:</i>		
• Immune system of plants	500	6
• Metabolomics	500	6
• Development & Evolution	500	6
Research Project(s) (at least 36 EC within the specialisation)	600	min. 60
Electives		max. 30

Electives/Optional elements

The optional part of the programme can consist of either additional courses or lectures, or an extension of the duration of a research project. A list of approved elective courses is available on the e-guide. For courses outside the LU biology programme and for all research projects, prior approval of the Board of Examiners is required. Note: maximally 12 EC of optional theoretical elements of level < 400 are permitted and max 15 EC non-biology courses.

Approval of programme

The individual study programme consisting of choices of courses and one or two research projects must have prior approval of the Board of Examiners

Short description of the Courses

The Plant Sciences and Natural Products study programme comprises several compulsory courses. The course *Orientation on Plant Sciences and Natural Products* provides a state of the art overview of the scientific research and research methods used in the departments participating in this MSc specialisation taken from presentations by group leaders and PhD students. The course “*Genomic Architecture*” aims at training students to become “genome-enabled” biologists by giving an overview of the structure, function and evolution of genomes. Together with the Advanced Statistics course, and one of the specialisation courses Immune Systems of Plants or Metabolomics, this will prepare the students theoretically for their training in scientific research during the Research Project(s).

Another obligatory element is the Top lectures series. This course consists of 6 lectures by internationally leading scientists in MCB- or EBC-oriented research fields relevant for the Plant Sciences programme. Students prepare for the lectures by reading scientific papers, and by discussion of these papers with the speaker.

At the beginning of the second semester (in year 1 or 2) students prepare individually from an advanced text book for a specialised examination. A variety of additional courses from other MSc specialisations in Biology and from other Msc programmes at the Faculty of Science and LUMC can be chosen as electives. Available book titles are provided in the electronic study guide (e-prospectus). For details (description, literature, exam dates and further calendar events) about the different courses see the e-prospectus and Blackboard.

¹ The orientation course can be replaced by an Orientation Course from a different specialisation

General Biology Programme (no research specialisation)

Programme (120 EC)

The MSc programme consists of:

- a theoretical part (30-60 EC)
- one or more research projects (60-90 EC).

The programme includes several compulsory components, mostly at the start of the programme, and can be expanded with a wide choice of elective elements. The mandatory components in the 1st semester aim to provide students with the theoretical and practical background needed for an efficient start of the specialisation Research Project at the end of this semester. The Research Projects are the actual core of the MSc programme. Students will be member of a research group of their choice and work full time on a specific project. Each project will be finished with an MSc thesis written in the form of a manuscript for an international scientific journal. At least one but preferably two Research Projects are part of the study programme.

At least one Research Project has to be done within a research area at the Institute Biology Leiden, the Faculty of Science, Naturalis Biodiversity Center, or Leiden University Medical Center. All Research Projects require prior approval by the Board of Examiners through approval of the individual study plan of a student and approval of the research agreement.

Compulsory components:

The compulsory theoretical components consist of at least 30 EC, and the minimum time to be spent on research projects is 60 EC. Each Research Project should be at least 30 EC.

The theoretical part comprises:

	Level	EC
<i>One of the courses:</i>		
• Orientation on Animal Biology and Disease Models	400	3
• Orientation on Evolution Biodiversity and Conservation	400	3
• Orientation on Microbial Biotechnology and Health	400	3
• Orientation on Plant Sciences and Natural Products	400	3
Genomic Architecture	400	6
Advanced Statistics	500	3
Top Lectures in MCB or EBC	500	3
Book exam	500	3
<i>12 EC out of the courses</i>		
• Mechanisms of Disease	500	6
• Development and Evolution	500	6
• Immune Systems of Plants	500	6
• Metabolomics	500	6
• Global Regulatory Networks in Bacteria	500	6
• Conservation Biology	500	6
• Methods in Biodiversity Analysis	500	6
• Behavioural Biology	500	3
• <i>Or courses from the list of approved electives</i>		
Electives		max. 30

Electives/Optional elements

The optional part of the programme can consist of either additional courses or lectures, or an extension of the duration of a research project. A list of approved elective courses is available on the e-guide. For courses outside the LU biology programme and for all research projects, prior approval of the Board of Examiners is required. Note: maximally 12 EC of optional theoretical elements of level < 400 are permitted and max 15 EC non-biology courses.

Approval of programme

The individual study programme consisting of choices of courses and one or two research projects must have prior approval of the Board of Examiners

MSc Life Science and Technology (LS&T)

CROHO-number 66286

The Leiden Institute of Chemistry (LIC) forms the basis for research and collaborations of the Leiden chemistry and life sciences groups. The two research areas in the LIC are *Chemical Biology* and *Energy and Sustainability*. The LIC offers four specialisations in the MSc LS&T programme; Life Science research and development (RESEARCH), Science-Based Business (SBB), Science Communication & Society (SCS) and Education (EDU).

The aim of each programme is to train the student as an independent researcher, and to develop the necessary skills and proficiency to advance his/her career.

The duration of each specialisation is two years (120 EC); a general overview of the four specialisations is given in Table 1. Students who complete the programme receive the degree Master of Science in LS&T, with specification of the specialisation.

All specialisations have the same Director, the same Board of Examiners, and the same Department Teaching Committee.

Table 1: Overview of the programmes of the four Leiden MSc LS&T specialisations

Specialisation	RESEARCH	EDU	SCS	SBB
Internship	60	30	30	30
Compulsory courses	24	24	24	24
Essay & Colloquium	6	-	-	-
Free electives ¹	30	36 / 6 ²	26	26
EDU/SCS/SBB components	-	30 /	40	40
Total	120	120	120	120

Admission procedure

Students from any university in the Netherlands with a BSc degree in Life Science & Technology will be admitted to the programme. All other (international) candidates, such as students with a degree related to Life Sciences, HBO Bachelors and foreign students have to apply for admission. As a guideline, the HBO-diploma has to be obtained within four years and with an average final mark above 7.5.

The Board of Admissions will judge the qualifications of the applicant on the basis of the curriculum and grades of his/her previous training. The admission process may include an interview with the Board of Admissions. Foreign applicants must provide proof of proficiency in English (IELTS level ≥ 6.5). The applicants for the EDU and SCS specialisations must provide proof of proficiency in Dutch. Admission is possible throughout the year, but we advise (foreign) students to start in September or February.

¹ The choice in the free electives is restricted to the boundaries specified here. A maximum of 20 EC can be used for extension of the internships.

² If the student has taken a minor Education (tweedegraadsbevoegdheid) of 30 EC in the BSc programme, only 30 EC are necessary in the MSc programme to obtain the "eerstegraadsbevoegdheid"; then 30 EC free electives are added to the programme of the MSc Life Science and Technology.

Programme

Each student composes his/her own study programme in consent with the mentor, who is a principal investigator of the LIC. The mentor is the supervisor of the major research internship of the specialisation in one of the major research areas as chosen by the student. The mentor will coach the student from the admission throughout the MSc programme. The choice in elective courses in the MSc programme may be limited by the need to adapt the programme to the present knowledge of the candidate. The intended programme may be adjusted during the course of the MSc programme. The study coordinator administrates a copy of the individual study programme; it is used to keep track of the student's progress and forms the basis of the master portfolio. The master planner is updated by the student on a regular basis. It is accessible to the student, the mentor and the study coordinator. The mentor discusses the progress of the student at least every half year using the results documented in the planner. The study coordinator will mediate when the student encounters problems in the interaction with the mentor.

Life Science & Technology researches the processes in the living cell. The cell is the building block of life, the smallest unit with the characteristics of living systems. Increased knowledge of the mechanisms of the cell can lead to better medicines, new methods for combating diseases. The master course Life Science and Technology (LST) is based on the Leiden University research profiling theme of "BioScience: Science base of Health". The study aims that students can understand the outcomes of molecular and structural chemistry and gain insight in basic targets underling various diseases. As important students can get knowledge in the fields of bio(medical) informatics and chemical tools for health-related applications. LST master students with an interest in the molecular chemical basis of Life Sciences can perform internships at the LIC, e.g. chemical biology or IBL and LACDR. Students with a medical preclinical biomedical interest can attend their internships at the LUMC, NKI or ErasmusMC. This program aims to equip students with knowledge and expertise on molecular and biomedical fundamental level, preparing them for careers in both industrial and academic environments. Biotechnological-, food- and biopharmaceutical industries as well as healthcare and fundamental research institutions are probable employers of our graduates.

Programmes of the specialisations

The programmes of the specialisations Science-Based Business, Science Communication & Society and Education are described separately in this Appendix.

Specialisation – Life science research and development (RESEARCH)

The research specialisation offers the student the opportunity to spend two full years on training and specialisation to become an independent and creative researcher. The MSc students will become a member and colleague in one of the research groups in the LIC. The student will develop her/his individual MSc programme together with mentor. The majority of the students with an MSc in Research in Life Sciences will continue their career in a PhD position.

The life science research and development programme consists of three parts: the research internship (60 EC), the compulsory courses (30 EC) and the elective courses (30 EC). A general overview of the programme is given in Table 1.

The (major) research internship is carried out within the Cell Observatory or related LIC research groups or IBL and LACDR. Our MSc students also have the opportunity to carry

out pre-clinical master projects in biomedical research institutes, including the LUMC, ErasmusMC and NKI.

The research internship includes a presentation and a written report (the master thesis). The major research internship is concluded with a presentation for an independent jury of two staff members, as well as interested students and staff members of the LIC (Thesis Talk). All students attend at least 10 Thesis Talks during their MSc program. The research internship may be split into two internships: the major and minor internship. The major internship is limited to 40-60 EC and the minor internship must comprise at least 20 EC. The topics of the minor and major internship project may be related which may be reflected in a combined master thesis. In consent with the mentor the minor internship can be carried out in another specialisation, another institute (within the Netherlands or abroad), or in industry. Prior approval of the Board of Examiners is required for an internship outside the institute. A staff member of the LIC has the final responsibility for the grading of the minor internship report of the research not carried out in the LIC.

The compulsory theoretical component comprises a selection of four core courses (24 EC) and a literature essay with colloquium (6 EC). All students attend at least 10 colloquia during their MSc program. The four core courses are chosen from the list of core courses as described below.

The elective component consists of a free choice of theoretical courses (30 EC). Alternatively, a maximum of 20 EC can be used to extend the research internships. The mentor may limit the choice in elective courses by the need to adapt the programme to the present knowledge of the student. Students can choose their electives from the list of core courses within or outside their research area, from the list of elective courses, the MSc courses offered in a Science Faculty of a Dutch university of level 400 or higher, or level 400 courses from the Bachelor programmes MST and LS&T provided that these courses were not part of the student's earlier programme. All other electives have to be approved by the Board of Examiners.

List of Core Courses

The LST master students have to choose 2 courses from the Molecular Sciences and 2 from the Biomedical Sciences. A list of the core courses in Life Science and Technology is given in Table 2.

Table 2: Core courses in Life Science and Technology. All courses are at level 400 or 500 and encompass 6 EC.

	Lecturer	Code
Molecular Sciences		
Molecular Chemistry	van der Marel	MC
Biomolecular Structures	Ubbink	SC
Chemical Genetics	Brouwer et al.	CG
Bio(medical) Sciences		
Genome organisation and maintenance in cancer and aging	Brouwer	GCA
Bio(medical) Informatics	Gulyaev	BMI
Global Regulatory Networks in bacteria	van Wezel	GRNB
In-vivo biomolecular interactions underlying diseases	Noteborn	IBID

Specialisation Science-Based Business

Description

The specialisation Science-Based Business (SBB) provides knowledge, insights and skills in the area of Management, Business and Entrepreneurship. Its focus is on their application in science- and research-driven organisations. Purpose is to broaden the horizon, to form an opinion on and prepare for a career in industry and to enhance competencies for pursuing entrepreneurial business opportunities created in science and research (Research-Based Business; RBB).

Qualifications for Admission

Admissible to the specialisation SBB are all students that are admitted to a Master Programme of the Faculty of Science or the Master Programme in Biomedical Sciences of the Faculty of Medicine (LUMC) provided that the rules and regulations of the subject Master Programme do allow so. In addition, foreign applicants must provide proof of proficiency in English with an IELTS ≥ 6.5 .

Exemptions

Students with prior education in management, business and entrepreneurship may – depending on the contents and extent of said education – be exempted from following (parts of) one or more of the Foundation courses. These courses need to be substituted such that their master programme contains at least 40 EC of management, business or entrepreneurship courses fitting in the context of science- and research based business. Decisions on exemptions and substitutions are taken by the Board of Examiners.

Programme

The programme of the Science-Based Business (SBB) specialisation consists of two components:

- a research component within the MSc programme
- a Science-Based Business *or* Research-Based Business component

Completion of the specialisation Science-Based Business requires a minimum of 40 EC and a maximum of 60 EC within the SBB component.

Research Component (60-80)

Mathematics

The Mathematics component of the Science-Based Business (SBB) specialisation consists of:

- a research project in Mathematics of 40 EC (incl. 7 EC for the master's thesis and an oral presentation) in one of the research groups of the Leiden Mathematical Institute,
- 20 EC of courses to be selected in correspondence with the research topic, and
- a mathematical project connected with the SBB training period.

Computer Science

The Computer Science component of the Science-Based Business (SBB) specialisation consists of:

- a research project in Computer Science of at least 42 EC (incl. 7 EC for the thesis and an oral presentation) in one of the research groups of LIACS, and
- at least 18 EC of level-500 courses to be selected in correspondence with the research topic.

The choices for courses and research project will be made in consultation with a supervisor. The Computer Science component can be extended with an additional 20 EC.

Astronomy

The Astronomy component of the Science-Based Business (SBB) specialisation consists of:

- a Medium Research Project (30 EC) supervised by a member of the Leiden Observatory scientific staff,

as well as courses to be selected in correspondence with the research topic to a minimum of 30 EC and a maximum of 50 EC.

These include at least:

- the mandatory course Stellar structure and evolution,
- one other Astronomy core course, and
- 8-14 EC of non-Astronomy courses.

Physics

The Physics component of the Science-Based Business (SBB) specialisation consists of:

- | | Level | EC |
|---|--------------|-----------|
| • Quantum Theory a | 400 | 6 |
| • Statistical Physics a | 400 | 6 |
| • Academic and Professional Skills ¹ | 400 | 2 |
- 10 EC of courses to be selected in correspondence with the research topic,
 - 6 EC of free electives,
 - a research project of 30 EC in one of the research groups of the Leiden Institute of Physics (LION) and a master's thesis and an oral presentation (5+1=6 EC).

The Physics component can be extended with an additional 20 EC.

Chemistry

The Chemistry component of the Science-Based Business (SBB) specialisation consists of:

- a research project in chemistry of 30 EC in one of the research areas (*Chemical Biology* or *Energy & Sustainability*) and includes a presentation for the research group and a written report (Master's Thesis). The research internship is concluded with a presentation for an independent jury of two staff members, as well as interested students and staff members of the LIC (Thesis Talk). All students attend at least 10 Thesis Talks during their MSc programme,
- 24 EC of compulsory courses in one of the research areas,
- 26 EC of free electives².

¹ This course consists of a number of modules which are offered during the programme.

² For the completion of 26 EC free electives the following rules apply:

- an extension of the research project is restricted to 20 EC, and
- no more than 20 EC can be used for SBB.

Bio-Pharmaceutical Sciences

The BPS component of the Science-Based Business (SBB) specialisation consists of:

- a research project of 50 EC in one of the research groups of the LACDR, consisting of 43 EC for practical work, 5 EC for a thesis and 2 EC for an oral presentation,
- two lecture series of 4 EC each,
- the course Scientific Conduct of 1 EC, and
- attendance of at least 20 colloquia or seminars (1 EC).

The choices for lecture series and research project will be made in concert with an adviser. The BPS component can be extended with an additional 20 EC.

Biology

The Biology component of the Science-Based Business (SBB) specialisation consists of:

- 24 EC of advanced theory
- a research project of 36 EC

The theoretical part of the Biology research components comprises:

	Level	EC
<i>One of the courses:</i>		
• Orientation on Animal Biology and Disease Models	400	3
• Orientation on Evolution Biodiversity and Conservation	400	3
• Orientation on Microbial Biotechnology and Health	400	3
• Orientation on Plant Sciences and Natural Products	400	3
Genomic Architecture	400	6
Advanced Statistics	500	3
Top Lectures in MCB or EBC	500	3
Book exam	500	3
<i>6 EC out of the courses</i>		
• Mechanisms of Disease	500	6
• Development and Evolution	500	6
• Immune Systems of Plants	500	6
• Metabolomics	500	6
• Global Regulatory Networks in Bacteria	500	6
• Conservation Biology	500	6
• Methods in Biodiversity Analysis	500	6
• Behavioural Biology	500	3
• <i>Or courses from the list of approved electives</i>		

The Biology component can be extended with an additional 20 EC (courses or extension of the research project to 80 EC in total). The research project has to take place in one of the research groups of the Institute Biology Leiden (IBL), Institute of Environmental Sciences (CML) or Naturalis Biodiversity Center.

A research project within one of the 'Life Science' research groups of the Leiden Institute of Chemistry (LIC), at the Leiden Academic Centre for Drug Research (LACDR) or at the Leiden University Medical Center (LUMC) may substitute for a research project within the IBL pending prior approval by the Board of Examiners. Theoretical components should be minimally at level 400. The individual study programme consisting of choices of courses and the research project must have prior approval by the Board of Examiners through approval of the individual study plan of a student and approval of the research agreement.

Life Science & Technology

The LS&T component of the Science-Based Business (SBB) specialisation consists of:

- a research project in Life Science and Technology of 30 EC including a presentation for the research group and a written report (Master's Thesis). The research internship is concluded with a presentation for an independent jury of two staff members, as well as interested students and staff members of the LIC (Thesis Talk). All students attend at least 10 Thesis Talks during their MSc programme.
- 24 EC of the compulsory courses within LS&T programme.
- 26 EC of free electives¹.

Science-Based Business (40-60)

The Science-Based Business component includes at least, either:

1. SBB Fundamentals (15 EC) and SBB Internship (25-35 EC); or
2. The RBB Foundation courses² (15 EC) and RBB Assignment (25-35 EC).

The SBB specialisation programme comprises at least 40 EC, the remaining 20 EC can be filled in with either SBB or RBB courses (as listed in the table below) or with components from the research component of the MSc programme.

Overview of Courses

	Level	EC
Foundation:		
- SBB Fundamentals	400	15
RBB Foundation courses:		
- Research Based Business Opportunities	400	5
- Research Based Business Ventures	400	5
- Research Based Business Planning	400	5
Advancement:		
- Learning from Silicon Valley: Entrepreneurship and New Business Venturing ³	500	5
- SBB/RBB Essay	500	3-7
- SBB/RBB Elective	400-600	3-15
Finishing:		
- SBB Internship	600	25-35
- RBB Assignment	600	25-35

¹ For the completion of 26 EC free electives the following rules apply:

- an extension of the research project is restricted to 20 EC, and
- no more than 20 EC can be used for SBB.

² If SBB Fundamentals is part of the programme, and the students opt for Research Based Business, then the RBB foundation course "RBB Opportunities" is not mandatory

³ The course 'Learning from Silicon Valley: Entrepreneurship and New Business Venturing' is offered in collaboration with Delft University of Technology and Erasmus University Rotterdam, and will only be taught when sufficient participants from all three universities are enrolled.

Specialisation Science Communication & Society

Description

The specialisation Science Communication & Society concerns science communication in a broad sense. The programme prepares students for a career in popularisation of science, for example, as a science communicator, a science policymaker or a public relations officer, or for a career as a scientist with a communicating mindset. Students with an MSc specialisation Science Communication & Society are admissible to a PhD programme in their MSc research or in Science Communication.

Qualifications for admission

Students should be admitted to an MSc programme within the Faculty of Science. For all other (international) candidates, the Board of Admissions will judge the equivalence to these BSc degrees of their previous training. Preferably, the BSc programme has included the 10-EC-course Learning, Presentation and Communication, offered by the Leiden University Graduate School of Teaching (ICLON), or equivalent courses.

Programme

The programme of the of the Science Communication & Society (SCS) specialisation consist of two components:

- a research component within the MSc programme
- a communication component

Completion of the specialisation SCS requires a minimum of 40 EC and a maximum of 60 EC within the communication component.

Research Component (60-80)

Mathematics

The Mathematics component of the Science Communication & Society (SCS) consists of:

- a project in mathematics of 40 EC (including a master thesis and an oral presentation) in one of the research groups of the institute, and
- 20 EC of courses to be selected in correspondence with the research topic.

The Mathematics component can be extended with an additional 20 EC.

Computer Science

The Computer Science component of the Science Communication & Society (SCS) consists of:

- a project in computer science of 42 EC (incl. 7 EC for the thesis and an oral presentation) in one of the research groups of the institute, and
- 18 EC of courses to be selected in correspondence with the research topic.

The Computer Science component can be extended with an additional 20 EC.

Astronomy

The Astronomy component of the Science Communication & Society (SCS) specialisation consists of:

- a Medium Research Project (30 EC) supervised by a member of the Leiden Observatory scientific staff,

as well as courses to be selected in correspondence with the research topic to a minimum of 30 EC and a maximum of 50 EC.

These include at least:

- the mandatory course “Stellar structure and evolution”,
- one other Astronomy core course, and
- 8-14 EC of non-Astronomy courses.

Physics

The Physics component of the Science Communication & Society (SCS) specialisation consists of:

- | | Level | EC |
|---|--------------|-----------|
| • Quantum Theory a | 400 | 6 |
| • Statistical Physics a | 400 | 6 |
| • Academic and Professional Skills ¹ | 400 | 2 |
| • 10 EC of courses to be selected in correspondence with the research topic. | | |
| • a research project of 30 EC in one of the research groups of the Leiden Institute of Physics (LION) and a master’s thesis and an oral presentation (5+1=6 EC) | | |

The Physics component can be extended with an additional 20 EC.

Chemistry

The Chemistry component of the Science Communication & Society (SCS) specialisation consists of:

- a research project in chemistry of 30 EC in one of the research areas (*Chemical Biology* or *Energy & Sustainability*) and includes a presentation for the research group and a written report (Master’s Thesis). The research internship is concluded with a presentation for an independent jury of two staff members, as well as interested students and staff members of the LIC (Thesis Talk). All students attend at least 10 Thesis Talks during their MSc programme.
- 24 EC of compulsory courses in one of the research areas.

The Chemistry component comprises 26 EC of free electives; an extension of the research project is restricted to 20 EC and no more than 20 EC can be used for SCS courses.

Bio-Pharmaceutical Sciences

The BPS component of the Science Communication & Society (SCS) specialisation consists of:

- a research project of 50 EC in one of the research groups of the LACDR, consisting of 43 EC for practical work, 5 EC for a thesis and 2 EC for an oral presentation,
- two lecture series of 4 EC each,
- the course Scientific Conduct of 1 EC, and
- attendance of at least 20 colloquia or seminars (1 EC).

The choice for lecture series and research project will be made in concert with an adviser. The BPS component can be extended with an additional 20 EC.

¹ This course consists of a number of modules which are offered during the programme.

Biology

The Biology component of the Science Communication & Society (SCS) specialisation consists of:

- 24 EC of advanced theory
- a research project of 36 EC

The theoretical part of the Biology research components comprises:

	Level	EC
<i>One of the courses:</i>		
• Orientation on Animal Biology and Disease Models	400	3
• Orientation on Evolution Biodiversity and Conservation	400	3
• Orientation on Microbial Biotechnology and Health	400	3
• Orientation on Plant Sciences and Natural Products	400	3
Genomic Architecture	400	6
Advanced Statistics	500	3
Top Lectures in MCB or EBC	500	3
Book exam	500	3
<i>6 EC out of the courses</i>		
• Mechanisms of Disease	500	6
• Development and Evolution	500	6
• Immune Systems of Plants	500	6
• Metabolomics	500	6
• Global Regulatory Networks in Bacteria	500	6
• Conservation Biology	500	6
• Methods in Biodiversity Analysis	500	6
• Behavioural Biology	500	3
• <i>Or courses from the list of approved electives</i>		

The Biology component can be extended with an additional 20 EC (courses or extension of the research project). The research project has to take place in one of the research groups of the Institute Biology Leiden (IBL), Institute of Environmental Sciences (CML) or Naturalis Biodiversity Center.

A research project within one of the 'Life Science' research groups of the Leiden Institute of Chemistry (LIC), at the Leiden Academic Centre for Drug Research (LACDR) or at the Leiden University Medical Center (LUMC) may substitute for a research project within the IBL pending prior approval by the Board of Examiners.

Theoretical components should be minimally at level 400. The individual study programme consisting of choices of courses and the research project must have prior approval by the Board of the Examiners through approval of the individual study plan of a student and approval of the research agreement.

Life Science & Technology

The LS&T component of the Science Communication & Society (SCS) specialisation consists of:

- a research project in Life Science and Technology of 30 EC including a presentation for the research group and a written report (Master's Thesis). The research internship is concluded with a presentation for an independent jury of two staff members, as well as interested students and staff members of the LIC (Thesis Talk). All students attend at least 10 Thesis Talks during their MSc programme.
- 24 EC of the compulsory courses within LS&T programme.

The programme comprises 26 EC of free electives; an extension of the research project is restricted to 20 EC and no more than 20 EC can be used for SCS courses.

Communication (40-60 EC)

The Communication component consists of the following:

	Level	EC
• Fundamentals of Science Communication and Society	400	17
• Project Proposal Communication	600	3
• Training period Communication	600	20-34
• Specialisation components	≥400	0-20

The training period will be in the field of science communication (e.g. science journalism, museology, new media, health communication) and includes a written report, and an oral presentation. The total training period includes a minimum of 10 EC of research in science communication.

The specialisation components can consist of:

- Courses within the research component of the MSc programme
- Courses in Communication
- Individual Book Examination
- Second Training Period
- Thesis or Literature Review

The choice of the training period, master thesis, and elective courses should be approved beforehand by the coordinator of the specialisation and the MSc programme coordinator.

Specialisation Education

Description

The MSc specialisation Education prepares students for a career in teaching in their subject matter specialisation. This programme leads up to the so-called “eerstegraadslesbevoegdheid”, qualifying the student to teach in Dutch upper secondary education in the school subject associated with the MSc programme as indicated in the table below.

Master programme	Qualifies for school subject
Mathematics	Wiskunde (Mathematics)
Physics	Natuurkunde (Physics)
Astronomy	Natuurkunde (Physics)
Chemistry	Scheikunde (Chemistry)
Bio-Pharmaceutical Sciences	Scheikunde (Chemistry) <i>or</i> Biologie ¹ (Biology)
Life Science Technology	Scheikunde (Chemistry)
Biology	Biologie (Biology)

Students with an MSc specialisation in Education are also admissible to a PhD programme in their MSc programme.

Qualifications for admission

Students should be admitted to an MSc programme within the Faculty of Science. For all other (international) candidates, the Board of Admissions will judge the equivalence to this BSc degree of their previous training. Applicants must provide proof of proficiency in Dutch.

Programme

The specialisation Education (EDU) consists of 60 EC in one of the MSc programmes of the faculty as listed below and 60 EC in Education.

When the student has passed the minor Education (30 EC) during the BSc programme, the compulsory education component is reduced with 30 EC. The remaining 30 EC can be used for both the education specialisation and the research component of the MSc programme. For LS&T and Chemistry the remaining 30 EC are restricted to the MSc programme.

¹ Students Bio-Pharmaceutical Sciences wishing to qualify for the school subject “Biology”, need to solve their deficiencies in the following subjects (in total 12 EC):

- Evolution (2 EC);
- Taxonomy (4.5 EC);
- Plant Physiology (2.5 EC);
- Ecology (2.5 EC); and
- Ethology (0.5 EC).

In consultation with the didactician Biology of the ICLON (parts of) the following courses of the bachelor programme in Biology can be taken as extracurricular courses to solve the deficiencies:

- Biodiversiteit Plant en Fylogenie (7 EC, level 100);
- Evolutie en Biodiversiteit Dier (6 EC, level 100); and
- Ecologie, Gedrag en Milieu (4 EC, level 200).

Research Component (60 EC)

Mathematics

The Mathematics component of the Education (EDU) specialisation consists of:

- a project in mathematics of 40 EC (incl. 7 EC for the thesis and an oral presentation) in one of the research groups of the institute, and
- 20 EC of courses to be selected in correspondence with the research topic.

Astronomy

The Astronomy component of the Education (EDU) specialisation consists of:

- a Medium Research Project (30 EC) supervised by a member of the Leiden Observatory scientific staff,

as well as courses to be selected in correspondence with the research topic to a total of 30 EC.

These include at least:

- the mandatory course Stellar structure and evolution,
- one other Astronomy core course, and
- 12 EC of non-Astronomy courses.

Physics

The Physics component of the Education (EDU) specialisation consists of:

- | | Level | EC |
|---|--------------|-----------|
| • Quantum Theory a | 400 | 6 |
| • Statistical Physics a | 400 | 6 |
| • Academic and Professional Skills ¹ | 400 | 2 |
- 10 EC of courses to be selected in correspondence with the research topic.
 - a research project of 30 EC in one of the research groups of the Leiden Institute of Physics (LION) and a master's thesis and an oral presentation (5+1=6 EC)

Chemistry

The Chemistry component of the Education (EDU) specialisation consists of:

- a research project in chemistry of 30 EC in one of the research areas (*Chemical Biology* or *Energy & Sustainability*) and includes a presentation for the research group and a written report (Master's Thesis). The research internship is concluded with a presentation for an independent jury of two staff members, as well as interested students and staff members of the LIC (Thesis Talk). All students attend at least 10 Thesis Talks during their MSc programme.
- 24 EC of compulsory courses within the MSc Chemistry programme.

Students are advised to select their compulsory courses from both research areas to guarantee a broad background in Chemistry. The programme comprises 6 EC of free electives. Students who have finished a minor Education of 30 EC in their BSc programme (tweedegraads lesbevoegdheid), need only 30 EC in their MSc programme to obtain the "eerstegraads lesbevoegdheid". The elective options for these students comprises 36 EC; an extension of the research project is restricted to 20 EC.

¹ This course consists of a number of modules which are offered during the programme.

Bio-Pharmaceutical Sciences

The BPS component of the Education (EDU) specialisation consists of:

- a research project of 50 EC in one of the research groups of the LACDR, including 5 EC for a thesis and 2 EC for an oral presentation,
- two lecture series of 4 EC each,
- the course Scientific Conduct of 1 EC, and
- attendance of at least 20 colloquia or seminars (1 EC).

The choices for lecture series and research project will be made in concert with an adviser.

Biology

The Biology component of the Education (EDU) specialisation consists of:

- 24 EC of advanced theory
- a research project of 36 EC

The theoretical part of the Biology research component comprises:

	Level	EC
<i>One of the courses:</i>		
• Orientation on Animal Biology and Disease Models	400	3
• Orientation on Evolution Biodiversity and Conservation	400	3
• Orientation on Microbial Biotechnology and Health	400	3
• Orientation on Plant Sciences and Natural Products	400	3
Genomic Architecture	400	6
Advanced Statistics	500	3
Top Lectures in MCB or EBC	500	3
Book exam	500	3
<i>6 EC out of the courses</i>		
• Mechanisms of Disease	500	6
• Development and Evolution	500	6
• Immune Systems of Plants	500	6
• Metabolomics	500	6
• Global Regulatory Networks in Bacteria	500	6
• Conservation Biology	500	6
• Methods in Biodiversity Analysis	500	6
• Behavioural Biology	500	3
• <i>Or courses from the list of approved electives</i>		

The research project has to take place in one of the research groups of the Institute Biology Leiden (IBL), Institute of Environmental Sciences (CML), or Naturalis Biodiversity Center. A research project within one of the 'Life Science' research groups of the Leiden Institute of Chemistry (LIC), at the Leiden Academic Centre for Drug Research (LACDR) or at the Leiden University Medical Center (LUMC) may substitute for a research project within the IBL pending prior approval by the Board of Examiners. Theoretical components should be minimally at level 400. The individual study programme consisting of choices of courses and the research project must have prior approval by the Board of Examiners through approval of the individual study plan of a student and approval of the research agreement.

Life Science & Technology

The LS&T component of the Education (EDU) specialisation consists of:

- a research project in Life Science and Technology of 30 EC including a presentation for the research group and a written report (Master's Thesis). The research internship is concluded with a presentation for an independent jury of two staff members, as well as interested students and staff members of the LIC (Thesis Talk). All students attend at least 10 Thesis Talks during their MSc programme.
- 24 EC of the compulsory courses within LS&T programme.

The programme comprises 6 EC of free electives. Students who have finished a minor Education of 30 EC in their BSc programme (tweedegraads lesbevoegdheid), need only 30 EC in their MSc programme to obtain the "eerstegraads lesbevoegdheid". The elective options for these students comprises 36 EC; an extension of the research project is restricted to 20 EC.

Education (60 EC)

The Education specialisation is offered as a joint programme of the faculty and the Leiden University Graduate School of Teaching (ICLON) and consists of the following components:

	Level	EC
Educational Theory	400	5
Learning and Instruction 1	300	5
Learning and Instruction 2	400	2
Teaching Methodology 1	400	5
Teaching Methodology 2	500	5
Design Research	600	7
Individual Choice	400	1
Teaching Practice 1		15
Teaching Practice 2		15

For students who passed the minor Education (30 EC) during the BSc programme, the programme consists of the following:

	Level	EC
Learning and Instruction 2	400	2
Teaching Methodology 2	500	5
Design Research	600	7
Individual Choice	400	1
Teaching Practice 2		15

The remaining 30 EC can be used for both the education specialisation and the research component of the MSc programme. For LS&T and Chemistry the remaining 30 EC are restricted to the MSc programme.